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Subject scope of *STAR,* and *IAA* includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

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02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

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VOLUME 25 NUMBER 14 / JULY 23, 1987

TABLE OF CONTENTS

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

01 AERONAUTICS (GENERAL) 1843

02 AERODYNAMICS 1844

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*

03 AIR TRANSPORTATION AND SAFETY 1846

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 1847

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 1848

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

06 AIRCRAFT INSTRUMENTATION 1849

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 AIRCRAFT PROPULSION AND POWER 1849

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

08 AIRCRAFT STABILITY AND CONTROL 1850

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

09 RESEARCH AND SUPPORT FACILITIES (AIR) 1851

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*

12 ASTRONAUTICS (GENERAL) N.A.

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

13 ASTRODYNAMICS N.A.

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) 1851

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

15 LAUNCH VEHICLES AND SPACE VEHICLES 1852

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

16 SPACE TRANSPORTATION 1852

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING N.A.

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 1853

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION 1856

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER 1856

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL) N.A.

24 COMPOSITE MATERIALS 1857

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY 1860

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS 1863

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 1868

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS 1871

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING 1873

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

31 ENGINEERING (GENERAL) 1876

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 1884

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING 1888

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER 1891

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY 1898

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS 1900

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING 1903

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 1908

Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 1909

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) 1915

43 EARTH RESOURCES AND REMOTE SENSING 1915

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION 1916

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION 1917

Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS 1918

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY 1923

Includes weather forecasting and modification.

48 OCEANOGRAPHY 1935

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

51 LIFE SCIENCES (GENERAL) 1938

52 AEROSPACE MEDICINE 1938

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES 1943

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT 1943

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY N.A.

Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) N.A.

60 COMPUTER OPERATIONS AND HARDWARE 1945

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE 1945

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS 1947

Includes computer networks and special application computer systems.

63 CYBERNETICS 1948

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS 1949

Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY 1950

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS 1951

Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS 1951

Includes topology and number theory.

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

70 PHYSICS (GENERAL) 1952

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS 1952
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 1954
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 1955
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 1956
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS 1957
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 1958
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 1963
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1964
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1964
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 1967
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1967
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) 1968

89 ASTRONOMY 1968
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 1969
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 1971
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 1972
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 1981
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

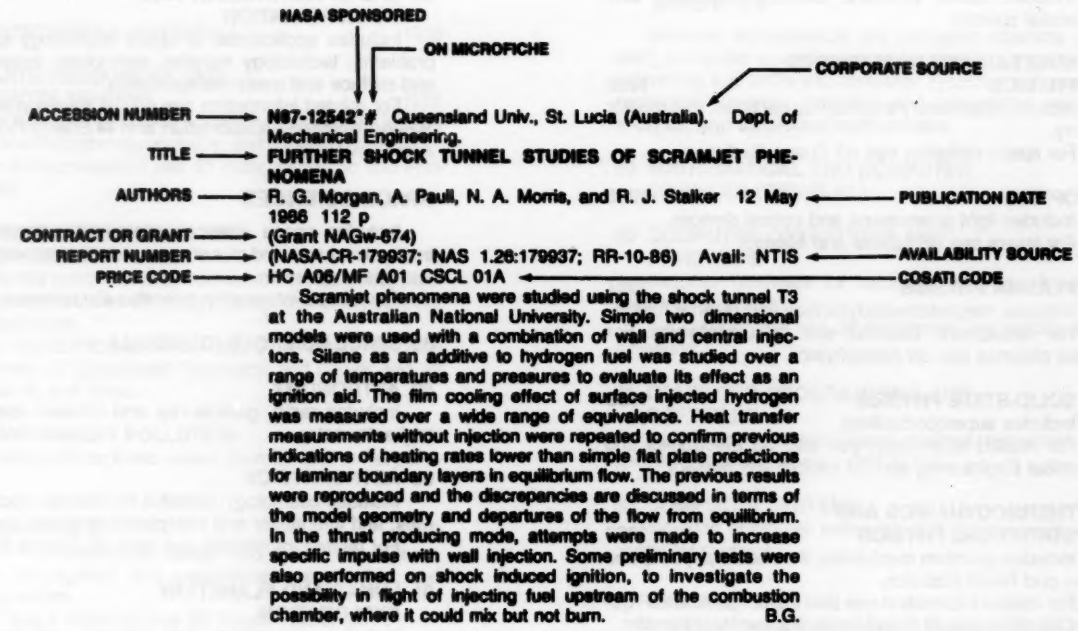
Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 1981

Note: N.A. means that no abstracts were assigned to this category for this issue.

SUBJECT INDEX I-1
PERSONAL AUTHOR INDEX I-55
CORPORATE SOURCE INDEX I-63
CONTRACT NUMBER INDEX I-75
REPORT/ACCESSION NUMBER INDEX I-77

TYPICAL CITATION AND ABSTRACT


NASA SPONSORED
ON MICROFICHE
CORPORATE SOURCE
ACCESSION NUMBER
N87-12542*# Queensland Univ., St. Lucia (Australia). Dept. of Mechanical Engineering.
TITLE
FURTHER SHOCK TUNNEL STUDIES OF SCRAMJET PHENOMENA
AUTHORS
R. G. Morgan, A. Paull, N. A. Morris, and R. J. Stalker 12 May 1986 112 p
PUBLICATION DATE
CONTRACT OR GRANT
(Grant NAGw-674)
REPORT NUMBER
(NASA-CR-179937; NAS 1.26:179937; RR-10-86) Avail: NTIS
AVAILABILITY SOURCE
PRICE CODE
HC A06/MF A01 CSCL 01A
COSATI CODE
Scramjet phenomena were studied using the shock tunnel T3 at the Australian National University. Simple two dimensional models were used with a combination of wall and central injectors. Silane as an additive to hydrogen fuel was studied over a range of temperatures and pressures to evaluate its effect as an ignition aid. The film cooling effect of surface injected hydrogen was measured over a wide range of equivalence. Heat transfer measurements without injection were repeated to confirm previous indications of heating rates lower than simple flat plate predictions for laminar boundary layers in equilibrium flow. The previous results were reproduced and the discrepancies are discussed in terms of the model geometry and departures of the flow from equilibrium. In the thrust producing mode, attempts were made to increase specific impulse with wall injection. Some preliminary tests were also performed on shock induced ignition, to investigate the possibility in flight of injecting fuel upstream of the combustion chamber, where it could mix but not burn. B.G.

VOLUME 25 NUMBER 14 / JULY 23, 1987

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N87-20954 Civil Aviation Authority, London (England).
LIGHT AIRCRAFT MAINTENANCE. GENERAL GUIDANCE ON IMPLEMENTATION OF THE LIGHT AIRCRAFT MAINTENANCE SCHEME (LAMS), FOR AIRCRAFT NOT EXCEEDING 2730 kg MTWA, WITH A CERTIFICATE OF AIRWORTHINESS IN THE TRANSPORT, AERIAL WORK OR PRIVATE CATEGORY
May 1986 44 p
(CAP-520; ISBN-0-86039-284-8; ETN-87-99501) Copyright. Avail: Issuing Activity

Owner's and operator's responsibilities in light aircraft maintenance; approval of organizations to carry out maintenance checks and to recommend renewal of certificates of airworthiness; maintenance schedules; log books; pilot maintenance; airworthiness flight tests; and engineering support arrangements for holders of Air Operators' Certificates are described. ESA

N87-20955* National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 213)
1987 126 p
(NASA-SP-7037(213); NAS 1.21:7037(213)) Avail: NTIS HC A07 CSCL 01A

This bibliography lists 423 reports, articles and other documents introduced into the NASA scientific and technical information system in April, 1987. Author

N87-20956* National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A CUMULATIVE INDEX TO A CONTINUING BIBLIOGRAPHY
1987 440 p
(NASA-SP-7037(209); NAS 1.21:7037(209)) Avail: NTIS HC A19 CSCL 01A

This bibliography is a cumulative index to the abstracts contained in NASA SP-7037 (197) through NASA SP-7037 (208) of Aeronautical Engineering: A Continuing Bibliography. NASA SP-7037 and its supplements have been compiled through the cooperative efforts of the American Institute of Aeronautics and Astronautics (AIAA) and the National Aeronautics and Space Administration (NASA). This cumulative index includes subject, personal author, corporate source, foreign technology, contract, report number, and accession number indexes. Author

N87-20957# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Net Shape Technology in Aerospace Structures.
NET SHAPE TECHNOLOGY IN AEROSPACE STRUCTURES. VOLUME 1 Final Report, 1984 - 1986
Morris A. Steinberg Nov. 1986 117 p
(Contract F49620-85-C-0107)
(AD-A176508) Avail: NTIS HC A06/MF A01 CSCL 13/8

This report is in four volumes. Volume 1 is the committee's assessment of the state of net shape technology for aerospace applications based on briefings and discussion at the workshops. This report is an assessment of current and possible applications of net shape technologies by the Air Force, including: precision forging of alloys, powder metallurgy, structural ceramics, superplastic forming, diffusion bonding, vapor deposited coatings, etc.; and composites, including organic matrix composites, metal matrix composites, ceramic and carbon matrix composites in the manufacture of aircraft components. It also includes road maps of research and development efforts in performance and manufacturing technologies and resource allocation. GRA

N87-20958# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Net Shape Technology in Aerospace Structures.
NET SHAPE TECHNOLOGY IN AEROSPACE STRUCTURES. VOLUME 2. APPENDIX. PRECISION FORGINGS IN AEROSPACE STRUCTURES. PRESENTATIONS OF A WORKSHOP HELD ON DECEMBER 3-5, 1984 IN OXNARD, CALIFORNIA Final Report, 1984 - 1986
Morris A. Steinberg Dec. 1986 420 p Workshop held in Oxnard, Calif., 3-5 Dec. 1984
(Contract F49620-85-C-0107)
(AD-A176509) Avail: NTIS HC A18/MF A01 CSCL 13/8

This report is in four volumes. Papers presented by invited speakers at the workshops appear in Volume 2 (precision forging). This document is an appendix to Net Shape Technology in Aerospace Structures, Vol. 1. It contains 22 reports by representatives of industry, the military, and academe on precision forgings in aerospace structures. These reports were presented at a workshop held Dec. 3 to 5, 1984 in Oxnard, California. GRA

N87-20959# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Net Shape Technology in Aerospace Structures.
NET SHAPE TECHNOLOGY IN AEROSPACE STRUCTURES. VOLUME 3. APPENDIX. EMERGING NET SHAPE TECHNOLOGIES. PRESENTATIONS OF A WORKSHOP HELD ON MARCH 27-29, 1985 IN SANTA BARBARA, CALIFORNIA Final Report, 1984 - 1986
Morris A. Steinberg Dec. 1986 526 p Workshop held in Santa Barbara, Calif., 27-29 Mar. 1985
(Contract F49620-85-C-0107)
(AD-A176510) Avail: NTIS HC A23/MF A01 CSCL 13/8

This report is in four volumes. Papers presented by invited speakers at the workshops appear in Volume 3 (emerging technologies). This document is an appendix to Net Shape Technology in Aerospace Structures, Vol. 1. It contains 30 reports by representatives of industry on emerging net shape technologies for the fabrication of aerospace parts. Technologies include: powder metallurgy, coatings, superplastic forming/diffusion bonding, hot isostatic pressing, ceramic-ceramic composites. These reports were presented at a workshop held March 27 to 29, 1985 in Santa Barbara, California. GRA

N87-20960# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Net Shape Technology in Aerospace Structures.
NET SHAPE TECHNOLOGY IN AEROSPACE STRUCTURES. VOLUME 4. APPENDIX. FUTURE COMPOSITE MANUFACTURING TECHNOLOGY. PRESENTATIONS OF A WORKSHOP HELD ON SEPTEMBER 9-12, 1985 IN GAITHERSBURG, MARYLAND Final Report, 1984 - 1986
Morris A. Steinberg Dec. 1986 689 p Workshop held in Gaithersburg, Md., 9-12 Sep. 1985
(Contract F49620-85-C-0107)
(AD-A176511) Avail: NTIS HC A99/MF A02 CSCL 13/8

This report is in four volumes. Papers presented by invited speakers at the workshops appear in Volume 4 (composites). This document is an appendix to Net Shape Technology in Aerospace Structures, Vol. 1. It contains 46 reports by representatives of industry and the military on the use of composites in the design and manufacture of aircraft parts. These reports were presented at a workshop held September 9 to 12, 1985 at the National Bureau of Standards in Gaithersburg, Maryland. GRA

N87-20961# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Aircraft and Engine Development Testing.
AIRCRAFT AND ENGINE DEVELOPMENT TESTING Final Report, 1984 - 1985
Sep. 1986 81 p
(Contract F49620-85-C-0107)
(AD-A176711) Avail: NTIS HC A05/MF A01 CSCL 14/2

This report is a study of the use, timing, and costs of development testing in the new aeronautical test facilities: the Aeropropulsion Systems Test Facility (ASTF), the National Transonic Facility (NTF), and the 80 ft x 120 ft low speed tunnel at NASA-Ames Research Center, California. GRA

N87-20962# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[ACTIVITIES REPORT IN SYSTEMS] Annual Report, 1985
Oct. 1986 24 p Original contains color illustrations
(ETN-87-99371) Avail: NTIS HC A02/MF A01

Numerical optimization of air combat maneuvers; icing of aircraft; integrated air data systems; flight tests of the Rustic ramrocket missile; additional propulsion force for projectiles; adaptive robust control of missiles; navigation aid by millimetric wave systems; optimization of geostationary satellite positioning with a low thrust motor; location of LEO satellites, a geostationary relay station; fine aiming system for intersatellite optical link; location of multiple paths of a VHF link; adaptive processing for thinned arrays; radar signature analysis; optimization of multilayer radar absorbent materials; sonar signature of complex objects; mechanical effects of high flux visible spectrum lasers on brittle materials, and optical degrading of infrared materials caused by exposure to rain are discussed. ESA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N87-20963 Cornell Univ., Ithaca, N.Y.
NUMERICAL GRID GENERATIONS FOR CASCADES WITH AND WITHOUT SOLUTION-ADAPTION Ph.D. Thesis
Jang-Hyuk Kwon 1986 150 p
Avail: Univ. Microfilms Order No. DA8623237

New efficient methods of numerical grid generation for cascade problems with and without solution-adaption are developed. A non-adaptive scheme which generates a body-fitted coordinate system for two-dimensional cascade problems is presented first, in which stretching functions are used to transform Laplace equations to the final computational domain. Although the resulting grid generating equations are linear and uncoupled, the quality of the generated grid is sensitive to the choice of boundary conditions. Two approximately conformal transformations are used for cascade problems to compute the boundary point distribution. Stretched and unstretched grids are generated for several cascade geometries to demonstrate the method. Two solution-adaptive grid generation techniques are presented next. The first scheme uses an integration of the curvature of the solution, where the area under the curvature curve is divided evenly to give the grid distribution. The second adaptive scheme uses Laplace equations with forcing functions as the grid generating equations. This scheme generates smooth grids with the smoothness generated by the characteristics of harmonic functions. Lastly, these adaptive grid generation schemes are employed for transonic flow calculations. The present schemes are very efficient relative to other schemes which are often used to generate grids. Dissert. Abstr.

N87-20964 Virginia Polytechnic Inst. and State Univ., Blacksburg.
LASER DOPPLER VELOCIMETER MEASUREMENTS IN A TURBULENT JUNCTION VORTEX Ph.D. Thesis
Iho Kuo Tree 1986 284 p
Avail: Univ. Microfilms Order No. DA8624348

An experimental investigation of an incompressible, turbulent junction vortex formed at the base of a streamlined cylinder with a circular leading edge placed normal to a flat surface is documented. The flow environment is characterized by a body Reynolds number of 183,000, based on the diameter of the model. The investigation centered around measurements of mean velocity vectors at over 1,700 locations on the plane of symmetry. In addition, extensive turbulence measurements in regions of interest on the plane of symmetry were also made. All of the measurements are performed with a two-color, two-component, frequency shifted laser Doppler velocimeter. The mean flow field shows the presence of a single vortex on the plane of symmetry and a singular separation point upstream of the vortex. From the measured data, the locations of the vortex center and the singular separation point were determined. The mean velocity field correlates well with previously published surface pressure data and surface flow visualization results. Dissert. Abstr.

N87-20965*# Eloret Corp., Palo Alto, Calif.
STUDY OF NON-EQUILIBRIUM TRANSPORT PHENOMENA
Surendra P. Sharma 12 May 1987 17 p
(Contract NCC2-418)
(NASA-CR-180441; NAS 1.26:180441) Avail: NTIS HC A02/MF A01 CSCL 01A

Nonequilibrium phenomena due to real gas effects are very important features of low density hypersonic flows. The shock shape and emitted nonequilibrium radiation are identified as the bulk flow behavior parameters which are very sensitive to the nonequilibrium phenomena. These parameters can be measured in shock tubes, shock tunnels, and ballistic ranges and used to test the accuracy of computational fluid dynamic (CFD) codes. Since the CDF codes, by necessity, are based on multi-temperature models, it is also desirable to measure various temperatures, most importantly, the vibrational temperature. The CFD codes would require high temperature rate constants, which are not available at present. Experiments conducted at the NASA Electric Arc-driven Shock Tube (EAST) facility reveal that radiation from steel contaminants overwhelm the radiation from the test gas. For the measurement of radiation and the chemical parameters, further investigation and then appropriate modifications of the EAST facility are required. Author

N87-20966*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.
IN-FLIGHT SURFACE OIL-FLOW PHOTOGRAPHS WITH COMPARISONS TO PRESSURE DISTRIBUTION AND BOUNDARY-LAYER DATA
Robert R. Meyer, Jr. and Lisa A. Jennett Apr. 1985 27 p Original contains color illustrations

(NASA-TP-2395; H-1184; NAS 1.60:2395) Avail: NTIS HC A03/MF A01 CSCL 01A

Upper surface oil-flow photographs were obtained at transonic speeds on an F-111 transonic aircraft technology (TACT) aircraft, which had been fitted with a natural laminar-flow airfoil section. The oil-flow photographs were interpreted with regard to shock and boundary-layer characteristics and compared to results obtained from pressure distributions and boundary-layer measurements. Results indicated that flow phenomena (such as shock location and strength) and chord location of boundary-layer characteristics (such as transition location) could be correctly identified from the oil-flow photographs. Author

N87-20967*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL DETERMINATION OF THE STABLE-TRIM ATTITUDES OF TWO PROPOSED, GENERAL-PURPOSE, HEAT-SOURCE MODULES

Robert L. Kruse May 1987 25 p

(NASA-TM-88345; A-86368; NAS 1.15:88345) Avail: NTIS HC A02/MF A01 CSCL 01A

Ballistic range tests have been conducted to determine the aerodynamically stable trim attitudes of two proposed general-purpose heat-source module configurations. Tests were conducted at speeds of 4.6 km/sec for the concept module, and at both 4.6 km/sec and 1.4 km/sec for the MOD II. Test results indicated that both configurations were stable when launched in the face-on attitude. When launched in the side-on attitude, the MOD II configuration was found to be stable, while tests of the concept module did not give definitive results. Author

N87-20968*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ALGORITHM IMPLEMENTATION ON THE NAVIER-STOKES COMPUTER

Steven E. Krist (Joint Inst. for Advancement of Flight Sciences, Hampton, Va.) and Thomas A. Zang Mar. 1987 76 p

(NASA-TM-89119; NAS 1.15:89119) Avail: NTIS HC A05/MF A01 CSCL 01A

The Navier-Stokes Computer is a multi-purpose parallel-processing supercomputer which is currently under development at Princeton University. It consists of multiple local memory parallel processors, called Nodes, which are interconnected in a hypercube network. Details of the procedures involved in implementing an algorithm on the Navier-Stokes computer are presented. The particular finite difference algorithm considered in this analysis was developed for simulation of laminar-turbulent transition in wall bounded shear flows. Projected timing results for implementing this algorithm indicate that operation rates in excess of 42 GFLOPS are feasible on a 128 Node machine. Author

N87-20969# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

EXPERIMENTAL STUDIES ON THE DYNAMIC DEVELOPMENT AND CONTROL OF UNSTEADY SEPARATED FLOWS Ph.D. Thesis

Henry E. Helin 1986 195 p

(AD-A176376; AFIT/CI/NR-87-21D) Avail: NTIS HC A09/MF A01 CSCL 20/4

It appears clear that substantial lift enhancement and stall delay are some of the beneficial consequences of certain unsteady aerodynamic conditions. Energetic vorticity dominated flows elicited through forced unsteady flow separation about a pitch airfoil were examined for a wide range of test conditions, including control oriented motion histories and model geometries. Phase locked high speed 16mm photography coupled with near surface hot wire anemometry and multi-port surface pressure measurements were used to quantify flowfield dynamics and the ensuing aerodynamic loading. The motion history employed as well as the model geometry had significant influences on the generation, coalescence and convection of the vortical structures. These studies suggest that certain aspects of unsteady separated flows and the resultant aerodynamic loading may be generated and controlled in a predictable and useful fashion. GRA

N87-20970# Douglas Aircraft Co., Inc., Long Beach, Calif.

AN APPROACH TO PRACTICAL AERODYNAMIC CALCULATIONS Interim Report

Tuncer Cebeci Feb. 1986 83 p

(Contract F49620-84-C-0007)

(AD-A176995; AFOSR-87-0063TR) Avail: NTIS HC A05/MF A01 CSCL 20/4

The emphasis of these lectures is on the numerical solution of three dimensional boundary layer equations using forms of Keller's Box scheme and interaction with solutions of inviscid flow equations. Calculations are described for the flow over a circular cylinder started impulsively from rest and a prolate spheriod at angle of attack and were obtained with prescribed free stream velocity distribution; the results emphasize the need for the Characteristic Box finite difference scheme, which automatically satisfies the numerical stability criterion in regions of flow where the w-velocity component is negative. Corresponding calculations, this time with a novel ellipse, over an oscillating airfoil and around wings are discussed. The results confirm that the interactive procedure provides accurate solutions, without numerical problems, in regions of flow separation. GRA

N87-20971# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

STUDIES IN NON-LINEAR UNSTEADY AERODYNAMICS Final Report, 25 Feb. 1982 - 14 Mar. 1985

J. C. Wu Oct. 1986 38 p

(Grant AF-AFOSR-0108-82)

(AD-A177006; AFOSR-87-0054TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

A research program in non-linear unsteady aerodynamics is summarized. New computational and theoretical methods ideally suited for viscous unsteady aerodynamic problems are described. Improved understanding of important physical processes involved in non-linear unsteady aerodynamics are discussed. Results are presented for three focal problems: (1) the Weis-Fogh problem, (2) the concept of trapping vortices, and (3) the vortex-airfoil interaction. GRA

N87-20972# Sandia National Labs., Albuquerque, N. Mex.

A SPATIAL MARCHING TECHNIQUE FOR THE INVISCID BLUNT BODY PROBLEM

R. T. Davis and F. G. Blottner (Cincinnati Univ., Ohio) 1987 12 p Presented at the AGARD Fluid Dynamics Panel Symposium, Bristol, Engl., 6 Apr. 1987 Prepared in cooperation with Cincinnati Univ., Ohio

(Contract DE-AC04-76DP-00789)

(DE87-004526; SAND-86-2960C; CONF-870473-1) Avail: NTIS HC A02

A technique has been developed for obtaining approximate solutions of the inviscid, hypersonic flow on a blunt body with a spatial marching scheme. The scheme introduces the Vigneron pressure gradient approximation into the momentum equation in the direction along the body surface. The resulting governing equations are hyperbolic. With a specified shock wave these equations are solved at the stagnation streamline with an iteration procedure and are solved in the downstream direction with a marching scheme. The complete Euler equations are solved with the numerical scheme when the flow is supersonic. A global iteration procedure is required to obtain the shock wave location. The approximate results from the spatial marching technique are compared with the complete solution of the Euler equations for flow over a sphere. The two results are shown to be in approximate agreement and the spatial marching technique provides useful engineering predictions while requiring considerably less computational time. DOE

N87-20973# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

[ACTIVITIES REPORT IN AERODYNAMICS] Annual Report, 1985

Oct. 1986 53 p Original contains color illustrations

(ETN-87-99372) Avail: NTIS HC A04/MF A01

Development of a panel method for complex configurations analyses; solution of the Euler equations; computation of massively separated flows by numerical viscid-inviscid interaction methods; calculation of the boundary layer-shock wave interaction in supersonic flow by a viscous-inviscid interaction numerical method shock wave - turbulent boundary layer interaction in three-dimensional channel flow; solution of the Navier-Stokes equations in compressible flow; modeling of turbulence in transonic interactions; computed evolution of a homogenous turbulence subjected to rotation effects; attractors for two-dimensional incompressible viscous flows; separations around different types of wings and fuselages; a wing section for light aircraft; profiles for helicopter blades; pressure distributions on flight-tested rotor blades; high-lift configurations; flow around a nacelle/pylon/wing system; unsteady pressure field in separated flow; flow in a three-dimensional air duct; flow through a cascade at high Reynolds number; the longitudinal aerodynamic characteristics of a missile; performance of the ejector of an altitude simulation test bench; ultralight wall wind tunnel; and a high frequency gust generator are discussed.
ESA

N87-20974# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NUMBER 1986-2, 231/MARCH-APRIL
Claude Sevestre, ed. Nov. 1986 86 p Transl. by ONERA into ENGLISH of 'La Recherche Aerospatiale, Bulletin Bimestriel (Paris), No. 1986-2, 231/Mar.-Apr. 1986"
(ESA-TT-998; ETN-87-99429) Avail: NTIS HC A05/MF A01; print copy in ENGLISH available at ONERA, Paris, France FF75; original report in FRENCH available at ONERA, Paris, France FF75

Analysis of velocity potential around intersecting bodies; a finite element program in cyclic viscoplasticity; functional reduction of stochastic fields for studying stationary random vibrations; dynamical vibrations of rotating laminated composite structures; numerical determination of the dynamic characteristics of a composite blade; reduction of turbulent skin friction via turbulence moderators; and a method for analyzing four-hot-wire probe measurements are discussed.
ESA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N87-20975 Civil Aviation Authority, London (England).
GROUND DE-ICING OF AIRCRAFT
Dec. 1985 20 p
(CAP-512; ISBN-0-86039-265-1; ETN-87-99497) Copyright. Avail: Issuing Activity

Maintenance and operational aspects of ground deicing of aircraft are discussed. Practices for safe cold weather operations are outlined. Conditions conducive to aircraft icing; and the effects of ice, snow, and frost accretions on aircraft performance and flight characteristics are described.
ESA

N87-20976 Civil Aviation Authority, London (England).
EXTENDED RANGE TWIN OPERATIONS (ETOPS)
Jan. 1986 34 p
(CAP-513; ISBN-086039-267-8; ETN-87-99498) Copyright. Avail: Issuing Activity

Acceptable means (but not necessarily the only means) by which approval may be given for UK-registered twin-engined airplanes to operate over a route that contains a point further than 1hr flying time (in still air) at the normal one-engine-inoperative cruise speed from an adequate aerodrome are described. The requirements apply to all twin-engined airplanes (including those powered by turboprops and reciprocating engines) flying for public transport, whose maximum authorized take-off weight exceeds 5700 lgs; and if the airplane is certificated to carry more than 19 passengers.
ESA

N87-20977 Civil Aviation Authority, London (England).
GROUND PROXIMITY WARNING SYSTEM (GPWS): GUIDANCE MATERIAL
Mar. 1986 14 p
(CAP-516; ISBN-0-86039-272-4; ETN-87-99499) Copyright. Avail: Issuing Activity

Information on the different categories of ground proximity alerts or warnings that may be encountered in flight, together with advice concerning the appropriate flight crew response to each case is presented. The limits of protection afforded by the equipment are described, and information on details that should be included in checklists, and Operations and Training Manuals is presented.
ESA

N87-20978# Defence Research Establishment, Ottawa. (Ontario).
CANADIAN COAST GUARD 406 MHz EPIRB (EMERGENCY POSITION INDICATING RADIOBEACON) EXPERIMENTAL RESULTS
Brian W. Kozminchuk and Suzanne Y. Slinn Nov. 1985 88 p
(AD-A176430; DREO-TN-86-10) Avail: NTIS HC A05/MF A01 CSCL 01C

This report presents the results of a series of 406 MHz Emergency Position Indicating Radiobeacon (EPIRB) experiments conducted by the Coast Guard in 1984, with the support of DREO and other organizations during the Demonstration and Evaluation (D and E) phase of the COSPAS/SARSAT system. The philosophy adopted in the design of the experiments was to assess the performance of the 406 MHz COSPAS/SARSAT system under a variety of operational circumstances which would provide useful information to the Coast Guard and the potential EPIRB user. In this respect, five experiments were conducted. The five experiments involved testing the EPRIB in various circumstances, such as onboard activations in SAR vessels and icebreakers, waterborne activations near waverider buoys and at high latitude locations. The experiments have yielded valuable information on the performance of the COSPAS/SARSAT system in a marine environment. The system has proven to be more accurate that the 121.5/243 MHz system, and versatile in a variety of operational circumstances.
Author

N87-20979# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
SELECTION OF PACKET SWITCHED FACILITIES FOR THE SEARCH AND RESCUE COMMUNICATIONS NETWORK BASED ON PERFORMANCE M.S. Thesis
Brian K. Livie and Gary M. Hallowell 1986 126 p
(AD-A176554; AFIT/CI/NR-87-1T) Avail: NTIS HC A07/MF A01 CSCL 17/2

Since September of 1982, survivors of aircraft and maritime disasters have been aided by a revolutionary new satellite system that has enabled search and rescue forces to locate, within hours and with virtual pinpoint accuracy, ships and aircraft in distress. This system, known as COSPAS/SARSAT (Space System for Search of Vessels in Distress/Search and Rescue Satellite Aided Tracking), combines the research efforts of several nations which began independent development of the idea in the early 1970's. Canada's Department of Communication (DOC), France's Centre National D'etudes of Spatiales (CNES), the United States' National Aeronautics and Space Administration (NASA), and the Soviet Union's Ministry of Merchant Marine (MORFLOT) make up the present partners in this joint venture of satellite-aided search and rescue.
GRA

N87-20980# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 14, 1985 ACCIDENTS
15 Sep. 1986 409 p
(PB86-916928; NTSB-AAB-86-28) Avail: NTIS HC A18/MF A01; also available on subscription, North American Continent

HC $185.00/year, all others write for quote CSCL 01C

The publication contains selected aircraft accident reports in Brief Format occurring in U.S. civil and foreign aviation operations during Calendar Year 1985. Approximately 200 General Aviation and Air Carrier accidents contained in the publication represent a random selection. The publication is issued irregularly, normally eighteen times each year. The Brief Format represents the facts, conditions, circumstances and probable cause(s) for each accident. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

N87-20981# Royal Aircraft Establishment, Farnborough (England).
DEVELOPMENTS IN AIR TRAFFIC CONTROL SYSTEMS AND THEIR RELATION WITH METEOROLOGY
T. H. M. Hagenberg Jan. 1986 22 p Transl. into ENGLISH of "Ontwikkelingen op het Gebied van Luchtverkeersleidingssystemen en de Relatie met Meteorologie" Rept. NLR-MP-84029-U National Aerospace Lab., The Netherlands, Mar. 1984 Original language document was announced as N85-27848
(RAE-Trans-2143; BR101808; NLR-MP-84029-U) Avail: NTIS HC A02/MF A01

Avionic systems such as secondary surveillance radar and microwave landing systems potential for further automation in air traffic control systems are discussed. The organization of air traffic services and the relation of these services with meteorology are outlined. Author

N87-20982*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTARY-WING AIRCRAFT TERRAIN-FOLLOWING/TERRAIN-AVOIDANCE SYSTEM DEVELOPMENT
Dan W. Dorr Jun. 1986 11 p Previously announced in IAA as A86-47456
(NASA-TM-88323; A-86283; NAS 1.15:88323) Avail: NTIS HC A02/MF A01 CSCL 17G

Work being accomplished to develop a real-time, piloted simulation of a helicopter using the vertical motion simulator at NASA Ames is discussed. The trajectory generation algorithm and the flight path controller are described, and the software integration of the entire terrain following/terrain avoidance (TF/TA) system is discussed. Real-time simulation requirements and the unique features of applying TF/TA system to helicopter flight are summarized. Initial results indicate that the system is satisfactory for automatic, low level TF/TA helicopter flight. Author

N87-20983# Defense Mapping Agency, Washington, D.C.
USE OF GPS (GLOBAL POSITIONING SYSTEM) FOR DYNAMIC POSITIONING OF HYDROGRAPHIC SURVEY PLATFORMS
Patrick J. Fell and William H. Wooden 1 Dec. 1986 12 p
(AD-A176218) Avail: NTIS HC A02/MF A01 CSCL 17/7

The Navstar Global Positioning System (GPS) is a satellite-based radio navigation system designed to provide continuous all-weather navigation to appropriately equipped users on a worldwide basis. The NAVSTAR system of navigation satellites may be exploited in several ways to support dynamic positioning of hydrographic survey platforms. Range observations from four satellites provide direct positioning in the World Geodetic System 1984 (WGS 84) terrestrial coordinate frame with an accuracy from 16 meters for the Precise Positioning Service (dual-frequency ranging) to 76 meters for the Standard Positioning Service (single-frequency ranging), spherical error probable. Higher precision is obtainable, especially for near-shore survey applications, using simultaneously measured phase observations acquired at sea and at land-based control points. With this method of positioning, the dynamic path of the survey vessel may be obtained with accuracies better than 1 meter. In addition to these applications, GPS may be used to determine survey vessel attitude and to establish undersea acoustic transponder control. This paper presents a synopsis of actual and anticipated results for each of these hydrographic surveying applications. GRA

N87-20984# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Accuracy of Time Transfer in Satellite Systems.
ACCURACY OF TIME TRANSFER IN SATELLITE SYSTEMS Final Report, 1984 - 1985
Clifford M. Will Sep. 1986 93 p
(Contract F49620-85-C-0107)
(AD-A176579) Avail: NTIS HC A05/MF A01 CSCL 22/2

This report evaluates and determines adequacy of corrections for relativistic effects in present Air Force programs to perform their mission, e.g., the global positioning system (GPS). It also determines adequacy of present methods for meeting Air Force mission needs and explains future uses and needs for time transfer, including use of time transfer to test the postulates of relativity theory. GRA

N87-20985# Naval Postgraduate School, Monterey, Calif.
ESTABLISHMENT OF SOFTWARE TO PROCESS GLOBAL POSITIONING SATELLITE DATA OBTAINED FROM TI 4100 GPS (GLOBAL POSITIONING SYSTEM) RECEIVERS M.S. Thesis
Marlene Mozgala Dec. 1986 88 p
(AD-A176793) Avail: NTIS HC A05/MF A01 CSCL 17/7

The U.S. Naval Postgraduate School (NPS) conducted Sea-floor Benchmark experiments in the summers of 1985 and 1986 which utilized the GPS satellite system as the principal source of ship positioning. The data acquired in 1985 had to be processed elsewhere as NPS lacked the software required to process the data. Software designed to process GPS satellite data was obtained from the U.S. National Oceanic and Atmospheric Administration/ National Geodetic Survey (NOAA/NGS). The programs which compute point positions from broadcast ephemeris information (collected using the U.S. government model of the TI 4100 GPS receiver) have been modified and tested, and are now fully operational at NPS on the IBM-3033 mainframe computer. The two programs to compute relative station positions have also been extensively modified for use on the IBM mainframe at NPS but still require further testing. NPS now has the capability of computing point positions from data collected on TI 4100 GPS receivers using broadcast ephemeris information. Author (GRA)

N87-20986# Royal Netherlands Meteorological Inst., De Bilt. Afdeling Fysische Meteorologie.
RUNWAY VISUAL RANGE (RVR) DOCUMENTATION OF THE CIVIL AIRPORTS IN THE NETHERLANDS [RVR-DOCUMENTIE VAN DE CIVIELE LUCHTHAVENS IN NEDERLAND]
A. H. C. Stalenhoef 1986 43 p In DUTCH
(KNMI-TR-84; B8668453; ISSN-0169-1708; ETN-87-99267) Avail: NTIS HC A03/MF A01

The way in which a runway visual range (RVR) table is established using transmissometer data (basic equations, visual thresholds for the perception of light sources, effective intensity of runway lights, composition of an RVR-table) is explained. The choice of the base length for the short base of the transmissometer and the transmissometer position are discussed. The RVR-tables used for civil airports equipped with transmissometers are presented. ESA

N87-20987# National Oceanic and Atmospheric Administration, Idaho Falls, Idaho.
LORAN-C TETROON TRANSPONDER AND TRACKING SYSTEM Final Report
K. L. Clawson, E. F. Pound, C. R. Dickson, and G. E. Start Oct. 1986 65 p Sponsored by EPA Prepared in cooperation with E.F.P. Co., Logan, Utah
(PB87-116687; EPA-600/3-86-060) Avail: NTIS HC A04/MF A01

CSCL 17G

An advanced system for tracking multiple regional scale Lagrangian markers was developed. The system consists of a miniature tetroon-borne transponder and a small computerized receiving station capable of providing continuous real-time data on tetroon location (latitude/longitude) and altitude. The transponder consists of a telemetry subsystem, a LORAN-C receiver, and a 403 MHz transmitter. The telemetry subsystem measures atmospheric temperature and pressure, converts the data into frequencies and then transmits these data together with a transponder ID frequency to a remote receiving station. Multiple tetroons can be discriminated at a range of up to 160 km. The transponder weighs less than 365 g and can be flown on a cub m tetroon. Battery life is 2 to 6 days. The data acquisition system consists of an FM receiver, a LORAN-C navigator, a frequency to digital converter, and a microcomputer. The receiving station can be ground-based or mounted in a single engine aircraft. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles see *85 Urban Technology and Transportation*.

N87-20988# Royal Aircraft Establishment, Farnborough (England).
AILERON REVERSAL OF SWEPT WINGS WITH CROSSFLEXIBILITIES
LI. T. Niblett Feb. 1983 24 p
(RAE-TR-83023; RAE-MAT/STR-36; BR88460; ETN-87-99813) Avail: NTIS HC A02/MF A01

Calculations were made on uniform wings with stiffness properties concentrated at a spanwise axis and the aileron alternatively placed inboard and outboard. Sweepback and sweepforward were considered. Strip theory aerodynamics were used. The results show that flexural flexibility reduces the aileron reversal speed of a sweptback wing when the aileron is outboard and increases it when the aileron is inboard. It has the opposite effect when the wing is sweptforward. In most practical cases, aileron reversal speeds are increased by negative crossflexibility when the aileron is outboard and by positive crossflexibility when the aileron is inboard. ESA

N87-20989# Royal Aircraft Establishment, Farnborough (England).
WING DIVERGENCE AND STRUCTURAL DISTORTION
LI. T. Niblett Jun. 1985 30 p
(RAE-TR-85057; RAE-MAT/STR-131; BR97881; ETN-87-99814) Avail: NTIS HC A03/MF A01

Static aeroelastic equations are formulated for an aircraft performing idealized pull-out and rolling maneuvers. It is concluded from the solutions of these equations that an unaugmented aircraft flying at speeds near the fixed-root divergence speed of its wing suffers low values of control angle per g and control effectiveness in roll and that the distribution of incidence across the wing varies considerably with speed. ESA

N87-20990*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SUMMARY OF STUDIES TO REDUCE WING-MOUNTED PROPFAN INSTALLATION DRAG ON AN M = 0.8 TRANSPORT
Ronald C. Smith, Alan D. Levin, and Richard D. Wood May 1987 29 p
(NASA-TP-2678; A-86242; NAS 1.60:2678) Avail: NTIS HC A03/MF A01 CSCL 01C

Powerplant installation losses for an advanced, high-speed, turboprop transport have been investigated in the Ames Research Center Transonic Wind Tunnels as a part of the NASA Advanced Turboprop Program (ATP). Force and pressure tests have been completed at Mach numbers from 0.6 to 0.82 on baseline and modified powered-model configurations to determine the magnitude of the losses and to what extent current design tools could be used to optimize the installed performance of turboprop propulsion systems designed to cruise at M = 0.8. Results of the tests indicate a large reduction in installed drag for the modified configuration. The wing-mounted power plant caused destabilizing pitching moments and a negative shift in the zero-lift pitching moment. Author

N87-20991*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHALLENGES IN MODELING THE X-29 FLIGHT TEST PERFORMANCE
John W. Hicks, Jan Kania (Air Force Flight Test Center, Edwards AFB, Calif.), Robert Pearce (Grumman Aerospace Corp., Edwards, Calif.), and Glen Mills Jan. 1987 14 p Presented at the AIAA 25th Aerospace Sciences Meeting, Reno, Nev., 12-15 Jan. 1987 Previously announced in IAA as A87-22402
(NASA-TM-88282; H-1395; NAS 1.15:88282; AIAA-87-0081) Avail: NTIS HC A02/MF A01 CSCL 01C

Presented are methods, instrumentation, and difficulties associated with drag measurement of the X-29A aircraft. The initial performance objective of the X-29A program emphasized drag polar shapes rather than absolute drag levels. Priorities during the flight envelope expansion restricted the evaluation of aircraft performance. Changes in aircraft configuration, uncertainties in angle-of-attack calibration, and limitations in instrumentation complicated the analysis. Limited engine instrumentation with uncertainties in overall in-flight thrust accuracy made it difficult to obtain reliable values of coefficient of parasite drag. The aircraft was incapable of tracking the automatic camber control trim schedule for optimum wing flaperon deflection during typical dynamic performance maneuvers; this has also complicated the drag polar shape modeling. The X-29A was far enough off the schedule that the developed trim drag correction procedure has proven inadequate. However, good drag polar shapes have been developed throughout the flight envelope. Preliminary flight results have compared well with wind tunnel predictions. A more comprehensive analysis must be done to complete performance models. The detailed flight performance program with a calibrated engine will benefit from the experience gained during this preliminary performance phase. Author

N87-20992# Naval Postgraduate School, Monterey, Calif.
HOVER PERFORMANCE OF A REMOTELY PILOTED HELICOPTER M.S. Thesis
Randolph P. Cotten Dec. 1986 56 p
(AD-A176587) Avail: NTIS HC A04/MF A01 CSCL 01/3

This paper discusses the hover performance of a remotely piloted helicopter (RPH) and the suitability of the use of this RPH in the academic environment of the Naval Postgraduate School Aeronautical Engineering Department. The methods are those used in the Helicopter Performance Test Manual of the U.S. Navy Test Pilot School. When testing remotely piloted aircraft for use with the military, there is a necessity to test a product to specifications. These specifications may be similar to those of a full sized aircraft. The test methods used are adequate for the testing of RPH's for specification but the use of this equipment in an academic environment is not safe enough without major modification. The RPH has enough excess lift to carry a small test instrumentation package in forward flight. If the RPH is used only in a laboratory environment for the demonstration of hover performance; the gas engine can be replaced with an electric motor and a plexiglas shield can be used between the students and the RPH to satisfy safety precautions. GRA

N87-20993# Naval Research Lab., Washington, D. C.
HARDWARE DESIGN FOR A FIXED-WING AIRBORNE GRAVITY MEASUREMENT SYSTEM Final Report, Jan. - Jul. 1986
John M. Brozena, James C. Eskinzes, and J. D. Clamons 22 Dec. 1986 39 p
(AD-A176620; NRL-9000) Avail: NTIS HC A03/MF A01

CSCL 08/5

This report describes the results of a hardware design study for an airborne gravity measurement system. The system is intended for use aboard a fixed wing aircraft for measurements over oceanic areas including ice caps. Hardware for measurement of total vertical acceleration including gravity, aircraft vertical acceleration, and precise positioning is discussed; and example equipment types are specified. A data acquisition system capable of handling all measurements sources is also specified. Various aircraft operational requirements and parameters are considered. GRA

N87-20994# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.

DEVELOPMENT OF OPTIMIZATION SYSTEM OPTSYS: IMPLEMENTATION OF STATIC AEROELASTIC CONSTRAINTS

Dag Wiklander Jun. 1986 14 p

(Contract FMV:FFL-82250-85-076-73-001)

(FFA-TN-1986-40; ETN-87-99444) Avail: NTIS HC A02/MF A01

A system for optimization of aircraft structures, OPTSYS, is presented. The implementation of static aeroelastic constraints is outlined. The calculation of flexibility matrices and derivatives of flexibility matrices with respect to design variables are described. These matrices are used in the aeroelastic analysis. The system is operational on VAX computers and CRAY-1A computers. ESA

N87-21455# European Space Agency, Paris (France).

TYPICAL AND HISTORICAL ASPECTS OF MOTOR GLIDERS AS METEOROLOGICAL MEASURING AIRCRAFT

Manfred E. Reinhardt *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 14-29 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 14-29 Original language document was announced as N85-35544 (For primary document see N87-21453 14-47)

Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N87-20995# Analytic Sciences Corp., Reading, Mass.

FAULT-TOLERANT SYSTEM ANALYSIS: IMPERFECT SWITCHING AND MAINTENANCE Final Technical Paper

Michael H. Veatch and Robert D. Foley Jan. 1987 32 p

(Contract F33615-82-C-0002)

(AD-A176514; AFHRL-TP-86-49) Avail: NTIS HC A03/MF A01 CSCL 09/5

Presented are the results of research into two important areas of concern for fault-tolerant avionics systems: testability analysis and innovative repair policies. The algorithms developed have been included in the Mission Reliability Model (MIREM) and verified by comparison with known results from several Integrated Communication, Navigation, and Identification Avionics architectures. The purpose of the testability analysis was to develop techniques for assessing the impact of imperfect switching on the overall reliability of fault-tolerant avionics. A method of quantifying the effects of undetected errors and false alarms has been developed and included in MIREM. Under the next phase of the program, three repair statistics were identified: Mean Time To Repair, Mean Time Between Maintenance Actions, and Inherent Availability. These were used to define four alternative repair policies: immediate repair, deferred repair, scheduled maintenance, and repair at degraded level. Also included in MIREM as model outputs, these four options offer greater flexibility in evaluating and developing avionics designs. GRA

N87-21467# European Space Agency, Paris (France).

DEVELOPMENT AND OPERATION OF A MEASURING DATA ACQUISITION SYSTEM FOR USE IN LIGHT AIRPLANES

Peter Huber *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 160-162 Transl. into ENGLISH from "Beitrag zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 157-160 Original language document was announced as N85-35556 (For primary document see N87-21453 14-47)

Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N87-20996*# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.

ON THE MODELLING OF NON-REACTIVE AND REACTIVE TURBULENT COMBUSTOR FLOWS Final Report

Mohammad Nikjooy and Ronald M. C. So Washington NASA Apr. 1987 282 p

(Grants NAG3-167; NAG3-260; Contract N60530-85-C-0191)

(NASA-CR-4041; E-3451; NAS 1.26:4041; CR-R86091) Avail: NTIS HC A13/MF A01 CSCL 21E

A study of non-reactive and reactive axisymmetric combustor flows with and without swirl is presented. Closure of the Reynolds equations is achieved by three models: kappa-epsilon, algebraic stress and Reynolds stress closure. Performance of two locally nonequilibrium and one equilibrium algebraic stress models is analyzed assuming four pressure strain models. A comparison is also made of the performance of a high and a low Reynolds number model for combustor flow calculations using Reynolds stress closures. Effects of diffusion and pressure-strain models on these closures are also investigated. Two models for the scalar transport are presented. One employs the second-moment closure which solves the transport equations for the scalar fluxes, while the other solves the algebraic equations for the scalar fluxes. In addition, two cases of non-premixed and one case of premixed combustion are considered. Fast- and finite-rate chemistry models are applied to non-premixed combustion. Both show promise for application in gas turbine combustors. However, finite rate chemistry models need to be examined to establish a suitable coupling of the heat release effects on turbulence field and rate constants.

Author

N87-20997# Allied Bendix Aerospace, Utica, N.Y. Fluid Power Div.

INVESTIGATION AND DESIGN OF A HIGH EFFICIENCY TURBINE WHEEL

L. Williams Aug. 1986 106 p

(Contract N00019-80-G-00607)

(AD-A176191; Rept-8720-3179U) Avail: NTIS HC A06/MF A01 CSCL 21/5

The objective of this task was to design a new turbine wheel to improve the reliability of the 36E144 Air Turbine Starter to be used on the LAMPS SH-60B helicopter. The program concentrated on strengthening and improving the turbine blade configuration. A stress analysis was conducted to determine the blading characteristics at severe operating conditions. An improved turbine wheel, P/N 2499860 was designed, fabricated, and exposed to a 2000 cycle starter qualification test at NAPC. When inspected after the test, the turbine was in excellent condition and completely free of any defects

or distress. The task objective to design and build a more reliable system was achieved. The efficiency level of the new turbine wheel design met Navy requirements. GRA

N87-20998# National Materials Advisory Board, Washington, D.C.
MATERIALS FOR LARGE LAND-BASED GAS TURBINES Final Report, 1984-1986
1986 110 p Sponsored by Electric Power Research Inst.
(PB87-120531; NMAB-430) Avail: NTIS HC A06/MF A01 CSCL 21E

Advanced large land-based gas turbines are expected to be a key component in the generation of electric power based on coal gasification and a combined-cycle gas turbine-steam turbine system. The development of gas turbines in the 120- to 150-MW range with turbine inlet temperatures of 2600 deg F at pressure ratios up to 16.1 is envisioned over the next 15 to 20 years. Currently available and developing materials technology useful for large machines is reviewed and discussed. Although the primary source of these developments is the aircraft engine field, other sources are also reviewed. Suitable technology appears to be available for the development of higher power, long-life turbines for utility power generation. Recommendations are made for specific research and development efforts that address the special requirements and environment of these machines. GRA

N87-21184# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering
VELOCITY AND TEMPERATURE MEASUREMENTS IN A CAN-TYPE GAS-TURBINE COMBUSTOR
A. F. Bicen, M. V. Heitor (Instituto Superior Tecnico, Lisbon, Portugal), and J. H. Whitelaw *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 12 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N87-20999* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRPLANE AUTOMATIC CONTROL FORCE TRIMMING DEVICE FOR ASYMMETRIC ENGINE FAILURES Patent
Eric C. Stewart, inventor (to NASA) Issued 10 Mar. 1987 7 p Filed 23 Oct. 1985 Supersedes N86-20397 (24 - 11, p 1720)
(NASA-Case-LAR-13280-1; US-Patent-4,648,569; US-Patent-Appl-SN-790556; US-Patent-Class-244-76-R; US-Patent-Class-340-967) Avail: US Patent and Trademark Office CSCL 01C

The difference in dynamic pressure in the propeller slipstreams as measured by sensors is divided by the freestream dynamic pressure generating a quantity proportional to the differential thrust coefficient. This quantity is used to command an electric trim motor to change the position of trim tab thereby retrimming the airplane to the new asymmetric power condition. The change in position of the trim tab produced by the electric trim motor is summed with the pilot's input to produce the actual trim tab position.
Official Gazette of the U.S. Patent and Trademark Office

N87-21000# Royal Aircraft Establishment, Farnborough (England).
DIVERGENCE AND FLUTTER OF SWEPT-FORWARD WINGS WITH CROSSFLEXIBILITIES
Ll. T. Niblett Apr. 1980 38 p
(RAE-TR-80047; RAE-Struct/BF/B/0816; BR75315; ETN-87-99812) Avail: NTIS HC A03/MF A01

The divergence and flutter of swept forward wings whose flexural and torsional displacements are coupled by crossflexibility were investigated. It is found that the effect of crossflexibility on divergence speed is reduced as the flexural flexibility is increased, the torsional flexibility being maintained constant. The presence of crossflexibility is unlikely to introduce serious flutter problems. Crossflexibility can be obtained by using fiber composites with asymmetric ply layups. The analysis of Mansfield (1979) applicable for wings of moderately-high and high aspect ratio, was used to relate asymmetry of layup and crossflexibility. ESA

N87-21001# Test Wing (4950th), Wright-Patterson AFB, Ohio.
ADVANCED ELECTROMECHANICAL ACTUATION SYSTEM (EMAS), FLIGHT TEST Final Report, Jul. 1985 - Mar. 1986
William J. Norton Jun. 1986 139 p
(AD-A176148; Rept-4950-FTR-86-4) Avail: NTIS HC A07/MF A01 CSCL 01/3

The EMAS flight test project successfully demonstrated, for the first time, the electrical actuation of a primary flight control surface in flight. This test was a major step toward the realization of the All-Electric Airplane (AEA) concept. An electric actuator was installed in a modified C-141A aircraft to power the left aileron. Testing included ground and flight trials to ensure unchanged control system damping. Aircraft roll performance tests included maximum effort rolls, degraded system rolls, and autopilot rolls. Sideslip and trim test points were also performed. It was verified that EMAS performance was similar to the normal hydraulic actuator. Results include lessons on aircraft modification, general system characteristics, maintenance factors, and compatibility with other aircraft systems that may influence future installations. GRA

N87-21002# Aeronautical Research Labs., Melbourne (Australia).
STATE CONSTRAINTS FOR PREDICTIVE CONTROL WITH AIR VEHICLE APPLICATION Systems Technical Memorandum
C. R. Guy Apr. 1986 33 p
(AD-A176205; ARL-SYS-TM-88) Avail: NTIS HC A03/MF A01 CSCL 01/4

The object of a predictive controller is to move the states of a plant from some finite initial conditions to some finite end conditions in a time-optimal, or sub-time-optimal way. To do this the plant is driven in an on-off manner; the controller calculates when the plant drive direction should be switched to give suitable control. The constraint algorithms allow such control to proceed while simultaneously enabling any state or combination of states to be restricted to a prescribed level. Algorithms are outlined for putting hard constraints on the values of the state variables in a system controlled using predictive (fast model) techniques and are applied to an air flight trajectory problem. Two algorithms are described, the first dealing with restrictions on the Nth state of an Nth order system and the second dealing with restrictions on the remaining state variables. To comprehend the constraint procedure, the principles of predictive control are briefly described with the aid of time history plots and phase plane portraits. Results are presented for constraints simultaneously applied to variables in a third order system and for a trajectory problem. The constraint algorithms are independent of the predictive control strategy. GRA

N87-21003# Aeronautical Research Labs., Melbourne (Australia).
ANALYSIS OF VIBRATION DATA FROM WHL (WESTLAND HELICOPTERS LIMITED) WESSEX FATIGUE TEST TRIAL 3
P. D. McFadden Aug. 1986 30 p
(AD-A176208; ARL/AERO-PROP-TM-436) Avail: NTIS HC A03/MF A01 CSCL 01/3

Broad band and narrow band enhancement and demodulation techniques are applied to the analysis of the signal averages of the vibration of the input spiral bevel pinion in a Wessex helicopter gearbox measured during a fatigue test. It is shown that the narrow band enhancement technique may be more sensitive to the presence of a crack in the gear than the broad band technique. It is confirmed that, as the affected teeth mesh, a phase lag in the vibration is produced which may be detected by narrow band demodulation. GRA

N87-21004# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT OF A MATHEMATICAL MODEL THAT SIMULATES THE LONGITUDINAL, AND LATERAL-DIRECTIONAL RESPONSE OF THE F/A-18 FOR THE STUDY OF FLIGHT CONTROL RECONFIGURATION M.S. Thesis
Fredric W. Rojek Sep. 1986 286 p
(AD-A176333) Avail: NTIS HC A13/MF A01 CSCL 01/3

A linearized mathematical model is developed which simulates the dynamic response of the Navy F/A-18 for the study of flight control reconfiguration. The aircraft is modeled as a multi-input multi-output, sampled data, closed system, which couples the dynamics of the flight control system to the aircraft linearized small perturbation equations. The discrete time, state variable equations for the system are then formulated. A computer program is developed which will compose the model matrices and compute the response of the aircraft to stick and rudder inputs. To study flight control reconfiguration, the model allows individual actuation of either a left or right control surface. Aircraft response to the actuation loss of either the left or right stabilator is simulated in the program. The program is designed to implement the reconfigurable control mixer, currently under study for the Self-Repairing Digital Flight Control System. The computer simulation was written in VS FORTRAN. A copy of the program and simulation results are included in the appendices. GRA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N87-21005# Smiths Industries Ltd., Bishops Cleeve (England). Aerospace and Defence Systems.
ELECTRONIC DISPLAY EQUIPMENT FOR USE IN THE ADVANCED FLIGHT DECK SIMULATOR AT BRITISH AEROSPACE, WEYBRIDGE Final Report
A. J. Pople Apr. 1986 18 p
(Contract MOD(PE)-A81A/1992)
(RID-1912; BR-99557; ETN-87-99455) Avail: NTIS Avail: NTIS HC A02/MF A01

Full color electronic display equipment was designed and constructed and installed in a flight deck simulator. A side-by-side arrangement of units was compared with the conventional vertical arrangement. ESA

N87-21006*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A NEW DESIGN CONCEPT FOR INDRAFT WIND-TUNNEL INLETS WITH APPLICATION TO THE NATIONAL FULL-SCALE AERODYNAMIC COMPLEX
James C. Ross, Lawrence E. Olson, Larry A. Meyn, and Johannes M. vanAken (Kansas Univ. Center for Research, Inc., Lawrence) Jan. 1986 13 p Previously announced in IAA as A86-19653
(NASA-TM-88226; A-85392; NAS 1.15:88226) Avail: NTIS HC A02/MF A01 CSCL 14B

The present inlet design concept for an indraft wind tunnel, which is especially suited to applications for which a specific test section flow quality is required with minimum inlet size, employs a cascade or vaneset to control flow at the inlet plane, so that test section total pressure variation is minimized. Potential flow panel methods, together with empirical pressure loss predictions, are used to predict inlet cascade performance. This concept has been used to develop an alternative inlet design for the 80 x 120-ft wind tunnel at NASA Ames Research Center. Experimental results show that a short length/diameter ratio wind tunnel inlet furnishing atmospheric wind isolation and uniform test section flow can be designed. Author

N87-21007 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[ACTIVITIES REPORT OF THE LARGE TESTING FACILITIES] Annual Report, 1985
Oct. 1986 27 p
(ETN-87-99376) Avail: NTIS HC A03/MF A01

Wind tunnel tests of the ACX Rafale fighter aircraft, of a transonic propeller, and of a transport aircraft; automatic systems, pressure measurements, and synthetic result displays; preparation of wind tunnel tests on motorized models with turbine-power simulators (TPS); extension of TPS calibration bench to reverse tests; rotary rake for probing the field around air intakes and determining the external drag; an air duct explorer; a supersonic variable-Mach nozzle for a wind tunnel; CAD software; and wind tunnel tests of a sailpower liner are summarized. ESA

N87-21192# Royal Aircraft Establishment, Farnborough (England).
DEVELOPMENTS IN DATA ACQUISITION AND PROCESSING USING AN ADVANCED COMBUSTION RESEARCH FACILITY
J. B. Bullard, F. S. E. Whitcher, and R. V. Steeden *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 16 p Previously announced as N87-16852 (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21205# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
PARTICLE IMAGING VELOCIMETRY IN A LOW TURBULENT WINDTUNNEL AND OTHER FLOW FACILITIES
J. Kompenhans and J. Reichmuth *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 13 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

No abstracts in this category.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N87-21008# Materials Research Labs., Melbourne (Australia).
EXPERIMENTAL RESULTS FROM RAILGUN FIRINGS INVOLVING MAGNETIC FLUX PROBES
V. Kowalenko Dec. 1986 42 p
(MRL-TN-509; AR-005-103) Avail: NTIS HC A03/MF A01

In the Magnetic RAPID Plasma Intensity Profiles (MRAP) series of railgun firings, the voltages induced in small solenoidal probes

mounted in different positions and orientations along the barrel were measured to gain a better understanding of the current density and magnetic field in a plasma armature. A summary of the results obtained from the probes is presented in this technical note. In addition, results obtained from the image analyses of streak films are presented together with some of the diagnostic records taken during the series. Author

N87-21009# Materials Research Labs., Melbourne (Australia).
THE MAGNETIC FLUX CONTRIBUTED BY THE PLASMA ARMATURE IN AN ELECTROMAGNETIC LAUNCHER
V. Kowalenko Nov. 1986 47 p
(MRL-R-1033; AR-005-102) Avail: NTIS HC A03/MF A01

The magnetic flux and the inductance due to the current passing through a plasma armature in an electromagnetic launcher is evaluated assuming that the current distribution within the armature is uniform. The expressions derived are then used by the computer program PLAFLUX.FOR to generate values for the plasma armature inductance and magnetic flux during acceleration. It is shown that the plasma armature inductance is negligible in comparison with the rail inductance. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N87-21010# Nielsen Engineering and Research, Inc., Mountain View, Calif.
PREDICTION OF THE AERODYNAMIC CHARACTERISTICS OF CRUCIFORM MISSILES INCLUDING EFFECTS OF ROLL ANGLE AND CONTROL DEFLECTION Final Report, 6 Jun. 1980 - 30 May 1986
Daniel J. Lesieutre, Michael R. Mendenhall, Susana M. Nazario, and Michael J. Hemsch (PRC Kentron, Inc., Hampton, Va.) 1 Aug. 1986 180 p
(Contract N00014-80-C-0700)
(AD-A176553; NEAR-TR-360) Avail: NTIS HC A09/MF A01 CSCL 16/2

A missile-fin data base for a wide range of configurations and flow conditions was obtained. These data were incorporated into an engineering method for predicting the aerodynamic characteristics of typical cruciform configurations over a wide range of angles of attack, fin deflection angles, roll angles, and Mach numbers. This report documents the test programs, describes the new code, MISSILE 3, and presents comparisons of independent experiment and predicted results to verify the code. A user's manual for the code is included. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N87-21011*# Eloret Corp., Palo Alto, Calif.
PERFORMANCE ANALYSIS OF ADVANCED SPACECRAFT TPS Progress Report, 1 Aug. 1986 - 28 Feb. 1987
William C. Pitts 3 Apr. 1987 38 p
(Contract NCC2-434)
(NASA-CR-180496; NAS 1.26:180496; EI87-0403) Avail: NTIS HC A03/MF A01 CSCL 22B

For the Space Shuttle several types of ceramic heat shield materials were developed, both flexible and rigid. Improvements on the materials are continuously evolving. Material properties that have been studied and improved are high temperature limits, material strength, surface ruggedness, and surface catalycity. The results are presented of preliminary analyses concerning the thermal protection systems of future spacecraft and their sensitivity to the above material properties. Author

N87-21012*# Remtech, Inc., Huntsville, Ala.
ORBITAL FLIGHT TEST SHUTTLE EXTERNAL TANK AEROTHERMAL FLIGHT EVALUATION, VOLUME 1
Sarat C. Praharaj, Carl D. Engel, and John D. Warmbrod Jun. 1986 234 p
(Contract NAS8-33373)
(NASA-CR-179074; NAS 1.26:179074; RTR-041-02-Vol-1) Avail: NTIS HC A11/MF A01 CSCL 22B

This 3-volume report discusses the evaluation of aerothermal flight measurements made on the orbital flight test Space Shuttle External Tanks (ETs). Six ETs were instrumented to measure various quantities during flight; including heat transfer, pressure, and structural temperature. The flight data was reduced and analyzed against math models established from an extensive wind tunnel data base and empirical heat-transfer relationships. This analysis has supported the validity of the current aeroheating methodology and existing data base; and, has also identified some problem areas which require methodology modifications. This is Volume 1, an Executive Summary. Volume 2 contains Appendices A (Aerothermal Comparisons) and B (Flight Derived h sub 1/h sub u vs. M sub inf. Plots), and Volume 3 contains Appendix C (Comparison of Interference Factors among OFT Flight, Prediction and 1H-97A Data), Appendix D (Freestream Stanton Number and Reynolds Number Correlation for Flight and Tunnel Data), and Appendix E (Flight-Derived h sub i/h sub u Tables). Author

N87-21013*# Remtech, Inc., Huntsville, Ala.
ORBITAL FLIGHT TEST SHUTTLE EXTERNAL TANK AEROTHERMAL FLIGHT EVALUATION, VOLUME 3
Sarat C. Praharaj, Carl D. Engel, and John D. Warmbrod Jun. 1986 361 p
(Contract NAS8-33373)
(NASA-CR-179076; NAS 1.26:179076; RTR-041-02-Vol-3) Avail: NTIS HC A16/MF A01 CSCL 22B

This 3-volume report discusses the evaluation of aerothermal flight measurements made on the orbital flight test Space Shuttle External Tanks (ETs). Six ETs were instrumented to measure various quantities during flight; including heat transfer, pressure, and structural temperature. The flight data was reduced and analyzed against math models established from an extensive wind tunnel data base and empirical heat-transfer relationships. This analysis has supported the validity of the current aeroheating methodology and existing data base; and, has also identified some problem areas which require methodology modifications. Volume 1 is the Executive Summary. Volume 2 contains Appendix A (Aerothermal Comparisons), and Appendix B (Flight-Derived h sub 1/h sub u vs. M sub inf. Plots). This is Volume 3, containing Appendix C (Comparison of Interference Factors between OFT Flight, Prediction and 1H-97A Data), Appendix D (Freestream Stanton Number and Reynolds Number Correlation for Flight and Tunnel Data), and Appendix E (Flight-Derived h sub i/h sub u Tables). Author

N87-21014*# Remtech, Inc., Birmingham, Ala.
ORBITAL FLIGHT TEST SHUTTLE EXTERNAL TANK AEROTHERMAL FLIGHT EVALUATION, VOLUME 2
Sarat C. Praharaj, Carl D. Engel, and John D. Warmbrod Jun. 1986 132 p
(Contract NAS8-33373)
(NASA-CR-179075; NAS 1.26:179075; RTR-041-02-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 22B

This 3-volume report discusses the evaluation of aerothermal flight measurements made on the orbital flight test Space Shuttle External Tanks (ETs). Six ETs were instrumented to measure various quantities during flight; including heat transfer, pressure,

and structural temperature. The flight data was reduced and analyzed against math models established from an extensive wind tunnel data base and empirical heat-transfer relationships. This analysis has supported the validity of the current aeroheating methodology and existing data base; and, has also identified some problem areas which require methodology modifications. Volume 1 is the Executive Summary. This is volume 2, containing Appendix A (Aerothermal Comparisons), and Appendix B (Flight-Derived h sub i/h sub u vs. M sub inf. Plots). Volume 3 contains Appendix C (Comparison of Interference Factors between OFT Flight, Prediction and 1H-97A Data), Appendix D (Freestream Stanton Number and Reynolds Number Correlation for Flight and Tunnel Data), and Appendix E (Flight-Derived h sub i/h sub u Tables). Author

N87-21015*# Lockheed Missiles and Space Co., Huntsville, Ala. Engineering Center.
FILAMENT WOUND DATA BASE DEVELOPMENT, REVISION 1, APPENDIX A
R. Scott Sharp and William F. Braddock Mar. 1985 288 p
(Contract NAS8-35054)
(NASA-CR-179069; NAS 1.26:179069;
LMSC-HREC-TR-D951500-1A) Avail: NTIS HC A13/MF A01 CSCL 22B

Data are presented in tabular form for the High Performance Nozzle Increments, Filament Wound Case (FWC) Systems Tunnel Increments, Steel Case Systems Tunnel Increments, FWC Stiffener Rings Increments, Steel Case Stiffener Rings Increments, FWC External Tank (ET) Attach Ring Increments, Steel Case ET Attach Ring Increments, and Data Tape 8. The High Performance Nozzle are also presented in graphical form. The tabular data consist of six-component force and moment coefficients as they vary with angle of attack at a specific Mach number and roll angle. The six coefficients are normal force, pitching moment, side force, yawing moment, axial force, and rolling moment. The graphical data for the High Performance Nozzle Increments consist of a plot of a coefficient increment as a function of angle of attack at a specific Mach number and at a roll angle of 0 deg. B.G.

N87-21016*# Lockheed Missiles and Space Co., Huntsville, Ala. Engineering Center.
FILAMENT WOUND DATA BASE DEVELOPMENT, REVISION 1 Final Report
R. Scott Sharp and William F. Braddock May 1985 96 p
(Contract NAS8-35054)
(NASA-CR-179068-Rev-1; NAS 1.26:179068-Rev-1;
LMSC-HREC-TR-D951500-1) Avail: NTIS HC A05/MF A01 CSCL 22B

The objective was to update the present Space Shuttle Solid Rocket Booster (SRB) baseline reentry aerodynamic data base and to develop a new reentry data base for the filament wound case SRB along with individual protuberance increments. Lockheed's procedures for performing these tasks are discussed. Free fall of the SRBs after separation from the Space Shuttle Launch Vehicle is completely uncontrolled. However, the SRBs must decelerate to a velocity and attitude that is suitable for parachute deployment. To determine the SRB reentry trajectory parameters, including the rate of deceleration and attitude history during free-fall, engineers at Marshall Space Flight Center are using a six-degree-of-freedom computer program to predict dynamic behavior. Static stability aerodynamic coefficients are part of the information required for input into this computer program. Lockheed analyzed the existing reentry aerodynamic data tape (Data Tape 5) for the current steel case SRB. This analysis resulted in the development of Data Tape 7. Author

N87-21017*# Lockheed Missiles and Space Co., Huntsville, Ala. Engineering Center.
FILAMENT WOUND DATA BASE DEVELOPMENT, REVISION 1, APPENDIX B
R. Scott Sharp and William F. Braddock Mar. 1985 970 p
(Contract NAS8-35054)
(NASA-CR-179070; NAS 1.26:179070;
LMSC-HREC-TR-D951500-1B) Avail: NTIS HC A99/MF E04 CSCL 22B

The data tape 8 data are presented in tabular form. Each page consists of six-component force and moment coefficients as they vary with angle of attack at a specific Mach number and roll angle. The angle of attack range is from 0 to 180 deg in 5 deg increments. The six coefficients are normal force, pitching moment, side force, yawing moment, axial force, and rolling moment. Each successive page is incremented for roll angle in 45 deg increments for a roll angle range from 0 to 360 deg. The cycle is then repeated for the next Mach number. The Mach numbers in the data base are 0.4, 0.5, 0.55, 0.6, 0.7, 0.8, 0.9, 0.95, 1.05, 1.1, 1.2, 1.4, 1.96, 2.5, 3.0, and 3.48. Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N87-21018*# General Dynamics Corp., Huntsville, Ala. Advanced Space Programs.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY. VOLUME 1A: EXECUTIVE SUMMARY. PHASE 2 Final Report
W. J. Ketchum Dec. 1986 55 p Sponsored by NASA
(NASA-CR-179055; NAS 1.26:179055; GDSS-SP-86-011-Vol-1A)
Avail: NTIS HC A04/MF A01 CSCL 22B

The objectives of the Phase 2 study were to improve the orbit transfer vehicle (OTV) concept definition by focusing on the following issues: the impact of mission requirements on OTV system design; OTV basing concepts on the Space Shuttle, separate platforms, and/or remote locations; cost reduction of an OTV program to improve its economic benefits and support its acquisition. The OTV mission scenario includes a wide range of missions the main drivers of which are manned GEO servicing, mid-inclination/polar DOD, and lunar/planetary projects. A mission model is presented which includes the type and number of missions per year and the estimated propellant requirements. To accomplish the missions, many OTV concepts were defined including ground-based OTVs launched either in the STS orbiter, the aft cargo carrier, or a heavy lift launch vehicle, and a space-based OTV. System and program trade studies were conducted using performance, cost, safety/risk, and operations/growth criteria. The study shows that mission requirements and substantial economic benefits justify a reusable, cryogenic (H2/O2) space-based OTV. Such a system would not be subjected to Earth-to-orbit launch loads and would not be constained in size or weight. Safety is enhanced by the fact that the system components are launched unfueled. Its inherent reusability and ability to be refueled in space make the space-based OTV very economical to operate. M.G.

N87-21019*# RCA Astro-Electronics Div., Princeton, N. J.
MARS OBSERVER: PHASE 0 SAFETY REVIEW DATA PACKAGE
17 Nov. 1986 121 p
(Contract JPL-957444)
(NASA-CR-180526; JPL-9950-1274; NAS 1.26:180526; TG27886; Rept-642-BA004/007) Avail: NTIS HC A06/MF A01 CSCL 22B

The Mars Observer Program has as its primary objectives a study of the geochemistry, atmospheric dynamics, atmosphere/surface interactions, seasonal variations, and magnetic field characteristics of Mars. The Mars Observer Spacecraft, safety critical spacecraft subsystems, ground support equipment, ground operations scenario, requirements matrix, and equipment specifications are described. B.G.

N87-21020*# Engineering, Inc., Hampton, Va.
THE RESULTS OF A LIMITED STUDY OF APPROACHES TO THE DESIGN, FABRICATION, AND TESTING OF A DYNAMIC MODEL OF THE NASA IOC SPACE STATION. EXECUTIVE SUMMARY
George W. Brooks Aug. 1985 150 p
(Contract NAS1-16610)
(NASA-CR-178276; NAS 1.26:178276; EI-278-R518) Avail: NTIS HC A07/MF A01 CSCL 22B

The options for the design, construction, and testing of a dynamic model of the space station were evaluated. Since the definition of the space station structure is still evolving, the Initial Operating Capacity (IOC) reference configuration was used as the general guideline. The results of the studies treat: general considerations of the need for and use of a dynamic model; factors which deal with the model design and construction; and a proposed system for supporting the dynamic model in the planned Large Spacecraft Laboratory. Author

N87-21021*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS OF ON-ORBIT THERMAL CHARACTERISTICS OF THE 15-METER HOOP/COLUMN ANTENNA
Gregory C. Andersen, Jeffery T. Farmer, and James Garrison (Rensselaer Polytechnic Inst., Troy, N.Y.) Mar. 1987 33 p
(NASA-TM-89137; NAS 1.15:89137) Avail: NTIS HC A03/MF A01 CSCL 22B

In recent years, interest in large deployable space antennae has led to the development of the 15 meter hoop/column antenna. The thermal environment the antenna is expected to experience during orbit is examined and the temperature distributions leading to reflector surface distortion errors are determined. Two flight orientations corresponding to: (1) normal operation, and (2) use in a Shuttle-attached flight experiment are examined. A reduced element model was used to determine element temperatures at 16 orbit points for both flight orientations. The temperature ranged from a minimum of 188 K to a maximum of 326 K. Based on the element temperatures, orbit position leading to possible worst case surface distortions were determined, and the subsequent temperatures were used in a static finite element analysis to quantify surface control cord deflections. The predicted changes in the control cord lengths were in the submillimeter ranges. Author

N87-21022# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
SATELLITES AND DEVELOPING COUNTRIES: PURPOSE, PROBLEMS, AND PROGRESS M.S. Thesis
Leroy A. Cassel 1986 126 p
(AD-A176538; AFIT/CI/NR-87-11T) Avail: NTIS HC A07/MF A01 CSCL 17/2

The use of satellites by countries of the Third World is examined. The orientation will be towards communication satellites. Satellite technology plays an important role in the telecommunication needs, and the benefits and capabilities provided by communication satellites define the purpose of that role. The utilization of satellite technology has not been without its problems. Two problems, the equitable use of the geostationary orbit and the slow implementation of rural satellite systems, are examined in detail. Despite problems, developing countries are making progress in the implementation of communication satellite systems. International, national, and private organizations contribute to the progress by providing aid and support to the developing world. Advancements in technology and a changing world market will give momentum to this progress in the future. An emphasis of the key points within the purpose, problems, and progress of this complex subject gives the reader an awareness of its future direction and an understanding of courses of action needed by countries to support their communication development. GRA

N87-21023# Naval Postgraduate School, Monterey, Calif.
DESIGN OF THE DIGITAL SATELLITE LINK INTERFACE FOR A SYSTEM THAT DETECTS THE PRECURSORY ELECTROMAGNETIC EMISSIONS ASSOCIATED WITH EARTHQUAKES M.S. Thesis
Kevin C. Ebel Dec. 1986 106 p
(AD-A176590) Avail: NTIS HC A06/MF A01 CSCL 08/11

The design, construction and implementation of a computer controlled radio frequency (RF) noise measurement and recording system in the 30.45 MHz and 150 MHz range and the interfacing of this sytem to a digital satellite link is presented. Earthquake prediction by the use of various physical precursors and the specific use of electromagnetic emissions in the RF range as a precursor to future earthquake activity is described. GRA

N87-21024# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
POTENTIAL MODULATIONS ON SCATHA (SPACECRAFT CHARGING AT HIGH ALTITUDE) SPACECRAFT
P. D. Craven, R. C. Olsen, T. Aggson, J. F. Fennell, and D. R. Croley, Jr. 30 Sep. 1986 36 p
(Contract F04701-85-C-0086)
(AD-A176815; TR-0086(6940-05)-13; SD-TR-86-92) Avail: NTIS HC A03/MF A01 CSCL 04/1

A small (1 volt) modulation of the spacecraft potential is observed on the SCATHA satellite through its effects on four instruments, two particle detectors and two field detectors. It is shown that there is a strong causal link between the modulation of the potential at this 1 volt level and a nonuniform distribution of the photoemissive properties of the conducting material on the surface of the satellite. GRA

N87-21025# Harris Corp., Melbourne, Fla. Government Aerospace Systems Div.
OPUS: OPTIMAL PROJECTION FOR UNCERTAIN SYSTEMS Annual Report, 1 Oct. 1985 - 1 Oct. 1986
Dennis S. Bernstein Oct. 1986 354 p
(Contract F49620-86-C-0002)
(AD-A176820; AFOSR-87-0161TR) Avail: NTIS HC A16/MF A01 CSCL 22/2

Increased interest in deploying large flexible spacecraft has focused attention on active structural control techniques to achieve crucial advances in vibration suppression, pointing accuracy and shape control. The extreme complexity of such systems and the lack of accurate finite-element structural models present severe control design challenges which were extensively accumulated by previous government research programs. OPUS is a rigorous new approach to this class of problems, which embodies a fundamental generalization of classical steady state linear quadratic Gaussian (LQG) optimal control theory. The present scope of the theory includes robust, reduced order modelling, estimation and control for continuous-time, discrete-time and sample data systems. GRA

N87-21026# Naval Postgraduate School, Monterey, Calif.
A THEORETICAL EXAMINATION OF A REENTRY CAPSULE INCORPORATING AN AUTOROTATING ROTOR M.S. Thesis
Robert G. Struth, Jr. Dec. 1986 72 p
(AD-A176854) Avail: NTIS HC A04/MF A01 CSCL 22/2

A theoretical analysis was conducted to determine the aerodynamic and performance characteristics of a capsule incorporating an autorotating rotor for recovery from Earth orbit. The potential advantages of this combination include the reduction

of landing speeds to improve the chances of successful emergency landings on water, uneven terrain, of during inclement weather. This thesis sought to determine the range, deceleration, and heating effects during the entire re-entry. Rotor-to-capsule diameter and rotor deployment time were varied along with type of recovery, i.e., capsule lifting or nonlifting. The addition of a rotor was found to provide a significant increase in lateral range capability while changing maximum deceleration only slightly; however, excessive aerodynamic rotor heating requires either delayed deployment (reducing the performance gains) or substitution/development of structural materials having higher heat resistance than those studied. GRA

N87-21027# York Univ. (England).
PROGRESS TOWARD PREDICTING HIGH-VOLTAGE CHARGING OF SPACECRAFT IN LOW POLAR ORBIT Report, 15 Jul. 1984 - 14 Jul. 1985
J. G. Laframboise and L. W. Parker 28 Oct. 1986 65 p
(Contract F19628-83-K-0028)
(AD-A176939; AFGL-TR-86-0261; SR-2) Avail: NTIS HC A04/MF A01 CSCL 22/2

This report presented a paper on The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications, The Hague, Netherlands, 2 to 6 June 1986. This paper is primarily of a survey nature, and contains relatively brief accounts of several aspects of the low polar orbit high voltage charging problem. However, it does present the first results from L. W. Parker's simulation work which was supported by this Contract. This report also contains the text of a paper on an expanded version of an earlier paper on secondary electron escape from negatively charged spacecraft surfaces in a magnetic field, and now includes results for situations in which there exist electric fields tangential as well as normal to the surface. GRA

N87-21028# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMMUNICATION SYSTEMS THROUGH ARTIFICIAL EARTH SATELLITES (SELECTED PAGES)
N. I. Kalashnikov 5 Feb. 1987 623 p Transl. into ENGLISH from the mono. "Sistemy Svyazi Cherez Iskusstvennyye Sputnik Zemli" Moscow, USSR, 1969 p 1-151, 159-286, 307-313, and 345-383
(AD-A176940; AD-E001309; FTD-ID(RS)T-1204-86) Avail: NTIS HC A99/MF A01 CSCL 17/2

This translation is of a Russian monograph. It examines the bases of calculation and principles of construction of communication systems through active Earth satellites, intended for transmission of large numbers of telephone conversations and television programs. Questions are presented which relate to selection of satellite orbits, calculation of levels of signals and qualitative indices of communication channels with different methods of modulation. The analysis of the specific features of the joint operation of communication system through artificial Earth satellites and radio relay lines of sight in the overall frequency band is given. GRA

N87-21029# Massachusetts Inst. of Tech., Cambridge. High Voltage Research Lab.
SPACE-CHARGE-INDUCED BREAKDOWN IN DIELECTRICS Final Report, 1 Jun. 1984 - 30 Sep. 1985
Chathan M. Cooke Jan. 1986 57 p
(Grant AF-AFOSR-0107-84)
(AD-A176969; AFOSR-87-0183TR) Avail: NTIS HC A04/MF A01 CSCL 22/2

The work included experimental tests and theoretical modeling of space charge effects. The tests employed energetic electron beams as a means to inject controlled quantities of charge into test specimens. The use of electron beams is relevant to certain practical applications such as radiation effects and spacecraft charging, as well as being an important diagnostic tool for dielectric materials and for e-beam transport studies. Author

N87-21030# WEA, Cambridge, Mass.
WAVE-MODE COORDINATES AND SCATTERING MATRICES FOR WAVE PROPAGATION Technical Report, 1 Sep. 1985 - 1 Oct. 1986
James H. Williams, Jr., Raymond J. Nagem, and Hubert K. Yeung 1 Oct. 1986 50 p
(Contract F49620-85-C-0148)
(AD-A176998; AFOSR-87-0021TR) Avail: NTIS HC A03/MF A01 CSCL 22/2

Wave-mode coordinates and scattering matrices are discussed in conjunction with the dynamic and wave propagation analyses of large space structures. Simple one-dimensional examples are given to illustrate how wave-mode coordinates and scattering matrices may be used to describe dynamics and wave propagation in such structures. GRA

N87-21031# Marconi Space Systems Ltd., Portsmouth (England).
TOWARDS AN OBJECT ORIENTED SATELLITE TEST ENVIRONMENT M.S. Thesis - Surrey Univ., Guildford, England
Martin Lihou 1986 65 p Sponsored by a GE Fellowship and the UK Science and Engineering Research Council
(ETN-87-99476) Avail: NTIS HC A04/MF A01

Satellite testing and programming languages, particularly ETOL, adopted as a European standard, are discussed. A user interface that is consistent throughout, very user friendly, and easy to use and understand is suggested. Implementation implications are considered, especially the type of language that is the most suitable. ESA

N87-21142*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ADVANCED LONG TERM CRYOGENIC STORAGE SYSTEMS
Norman S. Brown *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 7-16 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22B

N87-21143*# General Dynamics Corp., San Diego, Calif. Space Systems Div.
LONG TERM CRYOGENIC STORAGE FACILITY SYSTEMS STUDY
John R. Schuster *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 17-30 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22B

N87-21144*# Beech Aircraft Corp., Boulder, Colo.
SPACE STATION EXPERIMENT DEFINITION: LONG TERM CRYOGENIC FLUID STORAGE
David H. Riemer *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 31-42 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22B

N87-21477# Direction de la Meteorologie Nationale, Paris (France).
AUTOMATIC MOBILE PLATFORMS
Claude Pastre *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 133-144 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

N87-21478# Atmospheric Environment Service, Downsview (Ontario).
THE AIRCRAFT TO SATELLITE DATA RELAY: ASDAR
Jaan Kruss *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 145-155 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N87-21032# RADEX, Inc., Carlisle, Mass.
FLUXGATE MAGNETOMETER ANALYSIS AND SIMULATION SOFTWARE FOR THE COMBINED RELEASE AND RADIATION EFFECTS SATELLITE (CRRES)
William J. McNeil and Howard J. Singer 1 Oct. 1986 75 p
(Contract F19628-83-C-0105)
(AD-A176353; RX-861001; AFGL-TR-86-0222; SR-1) Avail: NTIS HC A04/MF A01 CSCL 22/2

A software package has been designed to simulate the operation of the fluxgate magnetometer to be flown on the Combined Release and Radiation Effects Satellite (CRRES). Algorithms are presented to create a one-second averaged data base from a simulated data stream from a spinning satellite in a realistic Earth's magnetic field. Methods are devised to perform on-orbit calibration, to despin the data and to use a model field for calibration. Expressions are presented for both the signals and errors in signals introduced by inaccurate calibration parameters. The time requirement for processing is estimated. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N87-21033# Royal Aircraft Establishment, Farnborough (England).
A SIMPLIFIED APPRAISAL OF THE PULSED PERFORMANCE OF ELECTROTHERMAL HYDRAZINE THRUSTERS
S. P. Field Dec. 1985 26 p
(RAE-TM-SPACE-355; BR99015; ETN-87-99469) Avail: NTIS HC A03/MF A01

A mathematical model which describes the transient thrust chamber pressure profile of an idealized Electrothermal Hydrazine Thruster (EHT) was developed. The model predicts the minimum pressure rise and decay times obtainable from pulsed thruster operation. Predicted and experimentally measured performance of a prototype EHT are compared, and it is shown that the simplified model provides a useful measure against which a thruster's experimental pulsed performance can be judged. Suggestions to improve experimental performance are made. ESA

N87-21034*# Morton Thiokol, Brigham City, Utah. Space Div.
BLOCK 2 SRM CONCEPTUAL DESIGN STUDIES. VOLUME 1, BOOK 1: CONCEPTUAL DESIGN PACKAGE Final Report
Brad Smith, Neal Williams, John Miller, Joe Ralston, Jennifer Richardson, Walt Moore, Dan Doll, Jeff Maughan, and Fred Hayes
19 Dec. 1986 275 p
(Contract NAS8-37296)
(NASA-CR-179048; NAS 1.26:179048; MTI-Pub-87354-Vol-1-Bk-1) Avail: NTIS HC A12/MF A01 CSCL 21H

The conceptual design studies of a Block 2 Solid Rocket Motor (SRM) require the elimination of asbestos-filled insulation and was open to alternate designs, such as case changes, different propellants, modified burn rate - to improve reliability and performance. Limitations were placed on SRM changes such that the outside geometry should not impact the physical interfaces with other Space Shuttle elements and should have minimum changes to the aerodynamic and dynamic characteristics of the Space Shuttle vehicle. Previous Space Shuttle SRM experience was assessed and new design concepts combined to define a valid approach to assured flight success and economic operation of the STS. Trade studies, preliminary designs, analyses, plans, and cost estimates are documented. B.G.

N87-21035*# Morton Thiokol, Brigham City, Utah. Space Div.
BLOCK 2 SRM CONCEPTUAL DESIGN STUDIES. VOLUME 1, BOOK 1: APPENDIX A: CEI SPECIFICATION CPW1-1900, APPENDIX B: COMPOSITE MOTOR CASE Final Report
19 Dec. 1986 171 p
(Contract NAS8-37296)
(NASA-CR-179049; NAS 1.26:179049; MTI-Pub-87354-Vol-1-Bk-1-App) Avail: NTIS HC A08/MF A01 CSCL 21H

The preliminary Contract End Item (CEI) specification presents the performance, design, and verification requirements for Morton Thiokol's Space Shuttle Block 2 Solid Rocket Motor (SRM). B.G.

N87-21036*# Morton Thiokol, Brigham City, Utah. Space Div.
BLOCK 2 SRM CONCEPTUAL DESIGN STUDIES. VOLUME 1, BOOK 2: PRELIMINARY DEVELOPMENT AND VERIFICATION PLAN Final Report
19 Dec. 1986 88 p
(Contract NAS8-37296)
(NASA-CR-179054; NAS 1.26:179054; MTI-Pub-87354-Vol-1-Bk-2) Avail: NTIS HC A05/MF A01 CSCL 21H

Activities that will be conducted in support of the development and verification of the Block 2 Solid Rocket Motor (SRM) are described. Development includes design, fabrication, processing, and testing activities in which the results are fed back into the project. Verification includes analytical and test activities which demonstrate SRM component/subassembly/assembly capability to perform its intended function. The management organization responsible for formulating and implementing the verification program is introduced. It also identifies the controls which will monitor and track the verification program. Integral with the design and certification of the SRM are other pieces of equipment used in transportation, handling, and testing which influence the reliability and maintainability of the SRM configuration. The certification of this equipment is also discussed. B.G.

N87-21037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE NASA ELECTRIC PROPULSION PROGRAM
David C. Byers and Robert A. Wasel (National Aeronautics and Space Administration, Washington, D.C.) 1987 22 p Presented at the 19th International Electric Propulsion Conference, Colorado Springs, Colo., 11-13 May 1987; sponsored by AIAA, DGLR and JSASS
(NASA-TM-89856; E-3524; NAS 1.15:89856; AIAA-87-1098) Avail: NTIS HC A02/MF A01 CSCL 21H

The NASA OAST Propulsion, Power and Energy Division supports electric propulsion for a broad class of missions. Concepts with potential to significantly benefit or enable space exploration and exploitation are identified and advanced toward applications in the near to far term. Recent program progress in mission/system analyses and in electrothermal, ion, and electromagnetic technologies are summarized. Author

N87-21038# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
ACOUSTIC-MEAN FLOW INTERACTIONS Final Report, Mar. 1983 - Dec. 1986
J. D. Baum and J. N. Levine Jan. 1987 61 p
(AD-A176845; AFRPL-TR-86-065) Avail: NTIS HC A04/MF A01 CSCL 21/2

The objective of this research work was directed at gaining understanding of the physical mechanisms by which energy is exchanged between the mean and acoustic flow fields in resonant combustion chambers (in particular, solid rocket motors). These processes may alter the balance between sources and sinks of oscillatory energy in the combustor significantly and thus are critical to our ability to predict the stability characteristics of proposed motor designs. The present report is concentrated on the description and analysis of the computational results obtained

to date in the study of acoustic refraction and flow turning phenomena. The time-dependent compressible Navier Stokes equations were solved utilizing an implicit, non-iterative Linearized Block Implicit scheme. In the first study acoustic wave propagation in a tube with a coexisting sheared mean flow was investigated. To help discriminate between acoustic energy loss due to artificial numerical dissipation and energy loss due to physical processes a second study was conducted in which acoustic wave propagation in a tube with no mean flow was investigated. The third study investigated acoustic wave propagation in a tube with a coexisting mean flow, where the mean flow is injected into the tube through its lateral boundary. GRA

N87-21039# Aerospace Corp., Los Angeles, Calif. Fluid Mechanics Dept.
DIRECT MONTE CARLO SIMULATION OF SMALL BIPROPELLANT ENGINE PLUMES Final Report, Mar. 1985 - May 1986
Yi C. Doo and Duane A. Nelson Jan. 1987 133 p
(AD-A177079; AFRPL-TR-86-100) Avail: NTIS HC A07/MF A01 CSCL 21/8

The prediction of rocket nozzle internal and external flowfields is an important aspect of space system design analysis, particularly with regard to exhaust plume contamination potential in the backflow region. For small engine plumes expanding into vacuum, the rarefied nonequilibrium effects both inside and outside the nozzle render the conventional continuum method of analysis invalid. To properly assess the backflow contamination flux due to inter-molecular collisions, molecular simulation of the flowfields is necessary. The objective is to subject such a simulation method to the scrutiny of a direct comparison with data taken from a simulated vacuum expansion of a 22.24N (51bf) rocket nozzle. The results of the successful application of the Direct Simulation Monte Carlo (DSMC) method to predict the mass flux density in the plume of a bipropellant engine are presented. The entire flow field starting from the nozzle throat extending to the backflow region has been calculated. Parameters varied in the simulation study include the nozzle area ratio and the internal degress of freedom of the gas mixture. The results from DSMC calculation for all cases exhibit the same magnitude and behavior as the experimental data within expected statistical scatter. The angular mass fluxes in the backflow region are nearly independent of the parameters examined. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials*.

N87-21040 North Carolina State Univ., Raleigh.
MULTI-AXIAL FAILURE CRITERIA IN FIBER COMPOSITES AND THEIR APPLICATION TO THE THROUGH-THICKNESS STRENGTH OF HYBRID FIBER LAMINATES Ph.D. Thesis
Seuk-Buom Kim 1986 139 p
Avail: Univ. Microfilms Order No. DA8624112

Three-dimensional stress analysis was done on thick (approximately 100 ply thick) interply hybrid laminates of the following ply angles: 0 deg (unidirectional), +/-15 deg, +/-30 deg and +/-45 deg (crossply), of T300 Graphite-epoxy/E Glass-epoxy and T300 Graphite-epoxy/Kevlar 49-epoxy fiber matrix. Compression was applied along the thickness direction. It became clear that the thickness strength of a laminate is very strongly influenced by the fiber orientations in the individual piles. Some angle-ply laminated composites showed negative values of Poisson's ratio when compressed along the thickness direction. Three-dimensional stress analysis of specimens compressed in the thickness direction was performed by using a Finite Element Method and calculation was done by using a computer code named ELAS. The predictions are compared to experimental results and the failure criteria are discussed and evaluated. Dissert. Abstr.

N87-21041# Royal Aircraft Establishment, Farnborough (England).
A COMPARISON OF THE FATIGUE PERFORMANCE OF WOVEN AND NON-WOVEN CFRP LAMINATES
P. T. Curtis and B. B. Moore Jun. 1985 101 p
(RAE-TR-85059; RAE-MAT/STR-133; BR99456; ETN-87-99468)
Avail: NTIS HC A06/MF A01

Static and fatigue tests were carried out at room temperature on CFRP laminates with five lay-ups, of woven and non woven CFRP. Carbon fiber reinforced plastics made with woven fabric have significantly poorer static and fatigue performance than non woven material, due to distortion of the load carrying 0 deg fiber. When woven fabric is oriented at 45 deg to the load direction the tensile static and fatigue performance is slightly better than in non woven + or - 45 deg material. Replacing the + or - 45 deg layers of a (+ or - 45.0) laminate with woven fabric has little effect on the static or fatigue strength. In non woven material, notched coupons under fatigue loading do not show the notch sensitivity that is so significant under static loading. However, in woven material, because of the additional fatigue degradation processes associated with two crossover points in the weave, holed coupons never quite achieve notch insensitivity in fatigue. ESA

N87-21042# MSNW, Inc., San Marcos, Calif.
PLASMA JOINING OF METAL MATRIX COMPOSITES Interim Technical Report, Apr. - May 1986
G. H. Reynolds and L. Yang Nov. 1986 12 p
(Contract DAAG29-85-C-0027)
(AD-A176690; ARO-22817.3-MS-S) Avail: NTIS HC A02/MF A01 CSCL 11/4

Microchemical characterization of the effects of low pressure transferred arc plasma processing on precomposited 1100 aluminum - 30 wt. % silicon carbide and Al - 5 wt. % titanium 30 wt. % SiC sub p powders is described. Author

N87-21043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STYRENE-TERMINATED POLYSULFONE OLIGOMERS AS MATRIX MATERIAL FOR GRAPHITE REINFORCED COMPOSITES: AN INITIAL STUDY
Dana Garcia (Goodrich, B. F. Co., Brecksville, Ohio), Kenneth J. Bowles, and Raymond D. Vannucci Apr. 1987 30 p
(NASA-TM-89846; E-3472; NAS 1.15:89846) Avail: NTIS HC A03/MF A01 CSCL 11D

Styrene terminated polysulfone oligomers are part of an oligomeric class of compounds with end groups capable of thermal polymerization. These materials can be used as matrices for graphite reinforced composites. The initial evaluation of styrene terminated polysulfone oligomer based composites are summarized in terms of fabrication methods, and mechanical and environmental properties. In addition, a description and evaluation is provided of the NASA/Industry Fellowship Program for Technology Transfer. Author

N87-21044# Surrey Univ., Guildford (England). Dept. of Materials Science and Engineering.
THE MICROMECHANICS OF DAMAGE INITIATION AND DEVELOPMENT UNDER STATIC AND FATIQUE LOADING OF CFRP XA-S/914 AND E-GLASS/913 LAMINATES Final Report
L. Boniface and M. G. Bader May 1986 121 p
(Contract D/ERI/9/4/2064/066-XR/MAT)
(BR-99985; ETN-87-99454) Avail: NTIS Avail: NTIS

HC A06/MF A01

Laminates were fabricated from CFRP XA-S 914 and GFRP E-glass/913 prepreg including unidirectional, 0/90/0, 0/90/45 and + or - 45 deg laminates. Development of damage in static and fatigue loading was monitored. The effects of laminate stacking sequence and off-axis ply thickness on threshold levels for the initiation and propagation of damage were evaluated. The effect of the cyclic loading level on the rate of damage accumulation was investigated, especially transverse ply cracking. Transverse cracks initiate at higher strains and reach a higher final density in laminates with thin 90 deg plies than in those with thick 90 deg plies. Fatigue loading produces extensive cracking and delamination and effectively lowers the damage thresholds observed in static loading. The sequence of damage in cyclic loading is similar to that in static loading although a form of secondary transverse ply cracking is observed in fatigue which does not develop monotonic conditions. ESA

N87-21045# Royal Aircraft Establishment, Farnborough (England).
THE EFFECTS OF IMPACT DAMAGE IN TAPERED-THICKNESS CFRP LAMINATES
R. T. Potter Oct. 1985 55 p
(RAE-TR-85087; RAE-MAT/STR-145; BR99601; ETN-87-99815) Avail: NTIS HC A04/MF A01

Experiments were carried out to evaluate potential interactions between barely-visible impact damage and tapered-thickness sections in carbon fiber reinforced plastic (CFRP) laminates. Interactions were assessed by study of the mechanisms of damage growth and failure under static and fatigue loading in tension and compression. Nondestructive testing, principally ultrasonics and penetrant-enhanced X-radiography was used. The information obtained by these methods was supplemented by fractographic analysis of selected specimens. Results suggest that significant interaction effects are possible but that they may be effectively eliminated by careful design of the taper. ESA

N87-21046# Aerospace Corp., El Segundo, Calif. Lab. Operations.
COMPRESSIVE PROPERTIES AND LASER ABSORPTIVITY OF UNIDIRECTIONAL METAL MATRIX COMPOSITES
D. L. Chang, G. L. Steckel, W. D. Hanna, and F. Izaguirre 30 Sep. 1986 35 p
(Contract F04701-85-C-0086)
(AD-A176194; TR-0084A(5935-14)-3; SD-TR-86-81) Avail: NTIS HC A03/MF A01 CSCL 11/4

Metal matrix composite use has been impeded because there is no well qualified property data base. Elevated temperature compressive properties and laser absorptivity data are in great demand in the design, modelling, and analysis of MMC structures in elevated temperature applications and survivability assessment. Testing methods were developed for room temperature and elevated temperature compressive modulus and strength measurements of single-ply unidirectional graphite-aluminum (Gr/Al) and graphite-magnesium (Gr/Mg), and to generate laser absorptivity data for these two types of materials. An effective gage length was established for valid compression tests to eliminate buckling failure. The measured failure strength values for Gr/Al and Gr/Mg are approximately 50 to 60% lower than the material tensile strength. Small gage strain gages are being used to measure the compressive modulus as a function of temperature. The laser absorptivities of Gr/Al and Gr/Mg were measured by the use of an in-house developed differential calorimeter. The calorimeter has been used to measure total hemispherical emittance and normal laser absorptance of specimens as a function of temperature from 200 to 700 C. Test results indicated that the laser absorptances of Gr/Al and Gr/Mg at 10.6 micrometer wavelength remain more or less constant over most of the temperature range tested. GRA

N87-21047# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
DEFECT AND DAMAGE CHARACTERIZATION IN COMPOSITE MATERIALS
I. M. Daniel, S. C. Wooh, and J. W. Lee Aug. 1986 10 p
(Contract N00014-82-K-0572)
(AD-A176335; NU-MML-TR-87-1) Avail: NTIS HC A02/MF A01 CSCL 11/4

Defects may be introduced in composites during processing and fabrication. They include contaminants, porosity, inclusions, delaminations, and nonuniform fiber and matrix distributions. Damage induced in service under loading and environmental variations includes matrix cracking, delamination, fiber breakage, and dispersed defects, such as matrix ageing and degradation. A variety of nondestructive evaluation methods have been used for composites, but the most effective and practical ones are ultrasonic and radiographic methods. These methods can be supplemented by others, such as acoustic emission, interferometric, and wave propagation techniques. The sensitivity and effectiveness of such NDE methods are discussed in connection with three applications: thick composites, metal-matrix composites, and fatigue damage. GRA

N87-21048# Florida Univ., Gainesville. Dept. of Engineering Sciences.
DELAMINATION SENSING AND MODELING IN LOCALIZED IMPACTS ON FILAMENT-REINFORCED LAMINATED PLATES Final Report, 1 Aug. 1983 - 30 Sep. 1986
L. E. Malvern and C. T. Sun 30 Nov. 1986 17 p
(Contract DAAG29-83-K-0107)
(AD-A176474; ARO-19946.8-EG) Avail: NTIS HC A02/MF A01 CSCL 11/4

In this analytical and experimental investigation on graphite/epoxy and Kevlar/epoxy laminates, ultrasonic C-scan and X-ray methods were used to determine delaminated areas, which were correlated with impactor-imparted kinetic energy. Transient flexural waves were studied. Residual strength and stiffness after impact at subperforation speeds were measured by three-point bend tests and correlated with the imparted kinetic energy. Since most of the results have been published, only brief summaries are given in this report along with references to the publications and a brief related bibliography. GRA

N87-21049# London Univ. (England). Dept. of Materials.
POLYDIACETYLENE SINGLE CRYSTAL FIBRES AND THEIR USE IN FIBRE-REINFORCED COMPOSITES Final Technical Report, 1985 - 1986
Robert J. Young and C. Galiotis Dec. 1986 30 p
(Contracts DAJA45-85-C-0025; DA Proj. 1L1-61102-BH-57)
(AD-A176927) Avail: NTIS HC A03/MF A01 CSCL 11/4

This project was concerned with the development of high modulus for use in fiber-reinforced composites. It is shown that theoretical calculations indicated that polydiacetylene single crystal fibers may have values of Young's moduli of up to 200GPa. An attempt was made to prepare good crystals of the derivative 1-hydroxy-hexa-2,4-diyne which should have a modulus of the order of 177GPa. Unfortunately it was not possible to prepare good single crystals of this derivative. All fibers prepared were only partly crystalline and contained some unpolymerized material. The crystals were so fragile that good mechanical property data could not be obtained. GRA

N87-21050# Northrop Corp., Hawthorne, Calif. Aircraft Div.
RESISTANCE CURVE APPROACH TO PREDICTING RESIDUAL STRENGTH OF COMPOSITES Final Report, Aug. 1984 - Aug. 1986
H. P. Kan, R. B. Deo, C. Shah, and R. Kinslow Sep. 1986 119 p
(Contract F49620-84-C-0077)
(AD-A176984; NOR-86-221; AFOSR-87-0062TR) Avail: NTIS HC A06/MF A01 CSCL 11/4

This report describes an analysis method to predict the static strength of a composite laminate with a delamination, using the resistance curve approach. Experimental data available in the literature were analyzed to establish Mode I and Mode II resistance curves and the mixed mode interaction criterion. A procedure to determine the Mode II resistance curve from mixed mode test data was discussed. An experimental program was conducted to

determine if composites exhibit resistance curve in Mode II. Two material systems were tested in the program. One of those systems was AS4/3501-6 which is representative of currently used graphite/epoxy materials. The second system was IM6/5245C which consists of an enhanced toughness matrix and high modulus, high strain to failure fibers. In addition, static compression tests were conducted on coupon specimens with through-the-width embedded delaminations to verify the analytical predictions. An analysis method was developed for residual strength prediction. The analysis is based on strain energy release rate approach. Strain energy release rate was computed at the delamination front at applied compressive stress levels above the initial buckling stress of the delamination. The residual strength was predicted using a multiple failure mode criteria. GRA

N87-21051# Drexel Univ., Philadelphia, Pa. Dept. of Electrical and Computer Engineering.

RESEARCH ON THE STATISTICS OF GRAIN LATTICE ECHOES AND THEIR USE IN GRAIN SIZE ESTIMATION AND GRAIN ECHO SUPPRESSION Annual Report, 30 Sep. 1985 - 30 Sep. 1986

V. L. Newhouse and Robert C. Disque 31 Dec. 1986 32 p
(Grant AF-AFOSR-84-0125)
(AD-A176996; AFOSR-87-0126TR) Avail: NTIS HC A03/MF A01 CSCL 11/6

A need exists for signal-to-noise ratio enhancement for noisy materials like centrifugally cast stainless steel, composite materials, some types of welded joints etc., because the echoes of interest in the signal will be sometimes completely obscured by noise. Split spectrum processing is a signal processing technique for the signal-to-noise ratio enhancement in ultrasonic signals. The method utilizes the frequency dependent response of the interfering coherent noise produced by unresolvable scatterers in the resolution range cell. It is implemented by splitting the frequency spectrum of the received signal by using Gaussian, overlapping bandpass filters and hence the name. Results of signal-to-noise ratio enhancement in signals obtained from real samples of centrifugally cast stainless steel, carbon-epoxy composite material and a 1020 steel welded joint are presented. The influence of various processing parameters on the performance of the processing technique is also discussed. An empirical algorithm, Polarity Thresholding, which provides an excellent signal-to-noise ratio enhancement when used in conjunction with Minimization is also presented. GRA

N87-21052# Oak Ridge National Lab., Tenn.

DEVELOPMENT OF ALUMINA- AND MULLITE-SiC WHISKER COMPOSITES: HIGH TEMPERATURE PROPERTIES

T. N. Tiegs and P. F. Becher 1986 6 p Presented at the Automotive Technology Development Contractors' Coordination Meeting, Dearborn, Mich.; 27 Oct. 1986
(Contract DE-AC05-84OR-21400)
(DE87-004624; CONF-861002-5) Avail: NTIS HC A02

The development of SiC whisker-reinforced ceramic composites is proceeding. At the present time, substantial fracture toughness and strength improvements for alumina and mullite matrix composites have been demonstrated. Equally important is that these properties are retained to temperatures of at least 1000 C. In addition, the alumina-SiC whisker composites have been shown to have excellent resistance to static fatigue at temperatures up to 1100 C. Degradation of the mechanical properties by oxidation is a potential problem for high-temperature structural applications. However, with the use of high purity matrices degradation can be minimized. DOE

N87-21053# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

LOCALIZED PLASTICITY OF GRAPHITE/MAGNESIUM METAL MATRIX COMPOSITES

J. S. Epstein, S. Rawal, and M. Misra 1986 25 p Presented at the Metal Matrix Composite Spacecraft Survivability Symposium, Palo Alto, Calif., 27 Oct. 1986 Prepared in cooperation with Martin Marietta Aerospace, Denver, Colo.
(Contract DE-AC07-76ID-01570)
(DE87-004542; EGG-M-20586; CONF-8610213-1) Avail: NTIS HC A02/MF A01

This paper discusses localized matrix plasticity in a pitch 55 graphite/magnesium (Gr/Mg) metal matrix composite (MMC) due to damping/hysteresis effects in bending. It was found that for this material system, chosen mainly for its damping ability, plasticity or permanent deformation occurs in the matrix material of the composite from relatively small structural deformations. The behavior of the plasticity is unique to these MMC systems as it is constrained to follow its original loading path back to its zero deformation state upon unloading. This retracement of loading path is attributed to the Gr fibers acting as elastic constraint layers. For optical rail platforms, the ability to recover the original platform shape, even with localized matrix plasticity, implies a high level of survivability. Moire interferometry was combined with research on the microstructure of this particular material system to yield these subtle results. DOE

N87-21054# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

[ACTIVITIES REPORT IN MATERIALS] Annual Report, 1985

Oct. 1986 24 p
(ETN-87-99374) Avail: NTIS HC A02/MF A01

Effect of crystal orientation on the creep properties of single-crystal superalloys; materials for honeycomb structures with high oxidation resistance at high temperatures; deposition of MCrAlY protective coatings by two-target triode sputtering, cyclic oxidation study of these coatings; an electrodeless plating bath for depositing very pure nickel; rapid solidification of titanium alloys reinforced by oxide particles; structural transformations in the titanium 10-2-3 alloy; precipitation of a quasi-crystalline phase in an Al-Li-Cu-Mg alloy; modeling the cooling and solidification of an Al-8 % Fe tape in melt spinning; a spectrograph for neutron diffuse scattering; Pd-V order effects; glass-ceramic matrix composites; thermokinetic analysis of heat barriers; microstructure of the interface and mechanical behavior of composite modules of CVD-deposited ceramic on SiC monofilaments; oxidation protection of carbon-carbon composites; fast-setting PSD resins and HSP resins; fragmentation techniques for measuring fiber-matrix adhesion; mode 1 crack propagation of unidirectional carbon-resin composites; and ultrasonic inspection of composite plates subjected to nonvisible impacts are described. ESA

N87-21055# Ecole Centrale de Lyon (France). Lab. de Mecanique des Solides.

CONTRIBUTION TO THE STUDY OF THE EPOXY-GLASS INTERFACES IN GLASS FIBER REINFORCED COMPOSITES Ph.D. Thesis [CONTRIBUTION A L'ETUDE DES ZONES INTERFACIALES DANS LES COMPOSITES POLYEPOXYDE-FIBRES DE VERRES]

Philippe Jeanne 1986 263 p In FRENCH
(ECL-86-10; ETN-87-99417) Avail: NTIS HC A12/MF A01

The reactive surfaces and the finish intermediate constituants of GFRP expoxy-glass interfaces are characterized using static and dynamic mechanical tests and electron microscope and scanning infrared microscope with Fourier analysis interpretation. It is shown that the structure of the aminosilane finish links are affected by finish preparation procedures, and several significant interactions of chemical physical nature are discovered. The practical consequences for composite manufacturing are discussed. ESA

N87-21056# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

ARAMID REINFORCED ALUMINUM LAMINATES: ARALL ADHESION PROBLEMS AND ENVIRONMENTAL EFFECTS. PART A: ADHESION AND DELAMINATION Ph.D. Thesis

Marcel Leona Clementine Eduard Verbruggen 1986 268 p
Sponsored by the Stichting Technische Wetenschappen
(ETN-87-99576) Avail: NTIS HC A12/MF A01

Delamination in the thin intermediate layers of ARALL, consisting of aramid fibers and metal adhesive was studied. Phenomen-

ological details of the delamination mechanisms in ARALL are given. The usefulness and limitations of different types of specimens to study delamination under mode 1, mode 2, and combined modes of loading is discussed. The application of fracture mechanics to understand the delamination behavior is assessed. ESA

N87-21057# Technische Hogeschool, Delft (Netherlands).
ARAMID REINFORCED ALUMINUM LAMINATES: ARALL ADHESION PROBLEMS AND ENVIRONMENTAL EFFECTS. VOLUME B: ENVIRONMENTAL EFFECTS ON DELAMINATION Ph.D. Thesis
Marcel Leona Clementine Eduard Verbruggen 1986 159 p
Sponsored by the Technische Technische Wetenschappen
(ETN-87-99577) Avail: NTIS HC A08/MF A01

Environmental effects on delamination in the thin intermediate layers of ARALL, consisting of aramid fibers and metal adhesive, were studied. The application of diffusion models to analyze moisture absorption by ARALL is described. Tests prove that the aramid fiber matrix adhesion is decreased in the presence of moisture. The moisture sensitivity applies to peel (mode 1) and shear (mode 2) fracture mechanisms. Under cyclic mode 1 loading, the degradation of the interface strength is technically significant. Because of the limited moisture pick-up of the ARALL material, the degradation is only present if the environment can directly enter the delamination tip. Comparison of the different environments shows that adhesion is sensitive to distilled or salt water environments, and that 70 C is the threshold temperature above which fast degradation occurs. Humid air environments (RH up to 80%) turn out to be far less aggressive. ESA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N87-21058 California Univ., Berkeley.
ON THE AERODYNAMICS OF FLAMES Ph.D. Thesis
Maciej Zenon Pindera 1986 153 p
Avail: Univ. Microfilms Order No. DA8624893

When in the analysis of combustion of premixed gases the diffusion of heat and species is ignored, the behavior of the flame and the surrounding gases can be described using only the conservation of mass and momentum equations, and by specifying the appropriate flame speed. Applying the general velocity decomposition principle, according to which a flowfield is comprised of distinct volumetric, rotation, and potential components, naturally leads to a model in which the flame is regarded as a surface source of volume. For low Mach number flows, the flowfield is treated as being slightly compressible, where all the compressibility effects take place at the flame interface. Inspection of the dynamic effects of such a model for the case of a two-dimensional finite open flame sheet, indicates that in addition the flame has to be regarded as a source of vorticity in order to satisfy the momentum equation, and to counteract the singularities in the flowfield set up by the volumetric effects. The effects of vorticity production on the velocity field are illustrated in several examples of steady and unsteady flow conditions. Author

N87-21059# Defence Research Information Centre, Orpington (England).
DEVELOPMENT OF CHEMICAL SENSORS: EMPIRICAL ART OR SYSTEMATIC RESEARCH?
W. Goepel Oct. 1986 49 p Transl. into ENGLISH from Technische Messen (West Germany), v. 52, no. 3, 1985 p 92-105
(DRIC-T-7783; BR100977; ETN-87-99466) Avail: NTIS HC A03/MF A01

The systematic development of chemicals is discussed. Electron exchange between particles and sensor surface; experimental requirements for an atomistic study of general particle/sensor relations; general reactions between particles and sensor surfaces; and sensor technique and heterogeneous catalysis are considered. ESA

N87-21060# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
DETERMINATION OF CHLORIDE IN HYDRAULIC FLUIDS Final Report, Mar. 1983 - Sep. 1984
Asha Varma Oct. 1986 13 p
(AD-A176406; NADC-86123-60) Avail: NTIS HC A02/MF A01 CSCL 07/2

In recent years, the adverse corrosion effects of chloride have become a great concern. Several analytical techniques have been reported in the literature for the determination of chloride in a variety of samples. The contamination of hydraulic fluids with seawater presents concern for the corrosion of an aircraft stationed on a carrier. An accurate, sensitive and a simple method, therefore, is required to monitor the chloride concentration and to assure proper function of the hydraulic system. In this report an improved ion selective electrode method for chloride in hydraulic fluids contaminated with seawater is presented. GRA

N87-21061# Rensselaer Polytechnic Inst., Troy, N.Y.
ADVANCED B AND Al COMBUSTION KINETICS STUDIES OVER WIDE TEMPERATURE RANGES Annual Report, 1 Dec. 1985 - 30 Nov. 1986
Arthur Fontijn Dec. 1986 12 p
(Grant AF-AFOSR-0019-86)
(AD-A176828; AFOSR-87-0140TR) Avail: NTIS HC A02/MF A01 CSCL 21/2

To help provide a better understanding of the temperature dependence of the kinetics of gas-phase metal oxidation reactions, experimental measurements were made in the 450 to 1750 K temperature regime using a high-temperature fast-flow reactor. The relative concentrations of the metallic species were monitored by laser-induced fluorescence. The following rate coefficient expressions were obtained (in cubic cm, per molecule, per second units): Aluminum + Chlorine Aluminum Chlorine + Chlorine, 7.9 X 10 to the minus 10th power exp(-780 K/T); Al + Hydrochlorine Acid Al Cl + Hydrogen, 1.5 X 10(-10) exp (-800 K/T); AlCl + Cl2 AlCl, 9.6 X 10 to the minus 11th power exp (-610 K/T); AlCl + Carbon Dioxide Oxy Aluminum Chloride + Co. To allow product identification in the latter and other reactions and make measurements on reactions of larger than diatomic radicals, a second reactor facility, in which the metallic species will be monitored by mass spectrometry, was designed. The construction of this facility nears completion. GRA

N87-21062# Aerospace Corp., El Segundo, Calif.
KINETICS OF SOME GAS PHASE ELEMENTARY REACTIONS OF BORON MONOFLUORIDE
Glenn C. Light, Ronald R. Herm, and James H. Matsumoto 1 Apr. 1986 50 p
(Contract F04701-85-C-0086)
(AD-A167690; SD-TR-86-20; TR-0086(6945-04)-1) Avail: NTIS HC A03/MF A01 CSCL 07/4

Rate coefficients for some elementary bimolecular reactions involving the molecule boron monofluoride (BF) were measured in a gas phase flowtube facility. The BF + Cl2 reaction was studied from 295 to 881 K. The rate coefficient is temperature independent with a value of 1.4 + or - 0.2 x 10 to the -11 cu cm3/molecule-sec. Reaction of BF with O2 was studied between 675 and 1033 K. The inferred Arrhenius rate is 1.8 x 10 to the -11 exp(-7240/T) cu cm3/molecule-sec. Room temperature rate coefficients for BF + O and BF + NO2 were determined to be 1.8 + or - 10 to the -10 and 2.1 + or - 0.3 x 10 to the -13 cu cm/molecule-sec, respectively. Reaction of BF was undetectable upon mixing with H2O, HF, CO2, NO, N2O, SO2, or CH3Cl. Upper limits are given for rate coefficients for these reactions. Boron monofluoride proved to be less reactive than other simple boron species which have been studied recently, namely, boron atoms and boron monoxide.

Results for BF are compared with available rate information for reactions of isoelectronic CO and N2. Author

N87-21063# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
INVESTIGATION OF THE CHARACTERISTICS OF LIQUID FUEL BURNING, RIJKE TYPE, PULSATING COMBUSTORS Annual Report
B. T. Zinn, B. R. Daniel, U. Katz, T. S. Xu, and A. Su Nov. 1986 65 p
(Contract DE-AS04-85AL-31881)
(DE87-001931; DOE/AL-31881/1) Avail: NTIS HC A04/MF A01

This report describes the results obtained during the first year of a DOE sponsored research program entitled Investigation of the Characteristics of Liquid Fuel Burning, Rijke Type, Pulse Combustors. This research has been concerned with the development of an efficient, nonpolluting, pulse combustor which burns liquid fuels. The design of the developed combustor is based upon principles of the acoustic Rijke tube which had been previously used, by the principal investigators of this study, to guide the development of a highly efficient, coal burning pulse combustor. The present study was initiated with the objective of determining whether the high performance achieved with the coal burning pulse combustor can be duplicated with the liquid fuel burning, Rijke type, pulse combustors. This document also describes the development of the experimental set-up and its subsequent modifications which resulted in improved performance. These studies revealed that pulse combustion operation can be maintained by more than one mechanism. DOE

N87-21064# California Univ., Los Angeles. Dept. of Physics.
RESEARCH ON THERMOPHYSICAL PROPERTIES OF MATERIALS Annual Report
G. Williams Aug. 1986 9 p
(Contract DE-FG03-86ER-45232)
(DE87-005682; DOE/ER-45232/1) Avail: NTIS HC A02/MF A01

Research progress is reported on nonlinear nonequilibrium properties of materials (localization of vibrational energy in condensed matter, acoustic models of nonlinear vibrational systems, nonlinear dynamical effects in convecting dilute solutions of He-3 in superfluid He-4 and on quantum fluids (superfluid He-4,spin-polarized hydrogen isotopes). DOE

N87-21065# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.
SUPERCRITICAL FLUID CHROMATOGRAPHY/SUPERSONIC JET SPECTROSCOPY Final Report, 1 Aug. 1983 - 31 Aug. 1986
M. L. Lee Dec. 1986 91 p
(Contract DE-FG22-83PC-60807)
(DE87-004004; DOE/PC-60807/T11) Avail: NTIS HC A05/MF A01

Capillary supercritical fluid chromatography (SFC) can be used to migrate and elute high-molecular-weight compounds that are present in coal-derived products, but the complexities of these mixtures surpass the resolving capabilities of this high resolution technique. In this study, the problem of sample complexity was addressed in two ways: (1) supercritical fluid sample prefractionation, and (2) capillary SFC with selective detection. For prefractionation, a supercritical fluid extraction/fractionation system was constructed and evaluated. A number of complex coal- and petroleum-derived materials were fractionated according to the number of aromatic rings using columns packed with an NH2-modified stationary phase bonded on silica particles, and the group type separation of aliphatics, olefins, and aromatics was accomplished with a combination of silica and silver nitrate-modified columns. DOE

N87-21066# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
TURBULENT PREMIXED FLAME STUDY Annual Progress Report
1986 11 p
(Contract DE-FG02-86ER-13553)
(DE87-006255; DOE/ER-13553/1; APR-1) Avail: NTIS HC A02/MF A01

A three year combined experimental and theoretical effort to study the behavior of turbulent premixed flames was started in July 1986. This effort is a continuation of an earlier program in which the propagation properties of spherical turbulent premixed flame had been studied in detail. The specific objectives of the experimental component in the current program are to examine the dynamic behavior of the flame structures and to study the effects of external aerodynamics on a propagating spherical flame ball in the wrinkled laminar flame regime. In the theoretical effort, the objective is to formulate and exercise a statistical model based on the dynamics of the flame surfaces. Then the detailed statistical data from the experiment will be compared with the model to elucidate the underlining physical principles. DOE

N87-21067# Institut National des Sciences Appliquees, Lyon (France). Lab. de Thermochimie Minerale.
PREPARATION AND CHARACTERIZATION OF POTASSIUM HYDROALUMINATES KAlH4, K3AlH6, K2NaAlH6, K3AlH4F2 Ph.D. Thesis [PREPARATION ET CARACTERISATION D'HYDROALUMINATES DE POTASSIUM KAlH4, K3AlH6, K2-NaAlH6. K3AlH4F2]
Jilali ElHajri 1986 132 p In FRENCH
(INSA-IDTC1-8602; ETN-87-99406) Avail: NTIS HC A07/MF A01

The experimental methods used for the synthesis of potassium hydroaluminates (extremely reactive compounds) and their characteristics are described. The laboratory set-up included a closed chamber under pure argon atmosphere and glove interface manipulators. Hydrogenation proceeds at high pressures (greater than 100 bar) using organic catalysis. The synthesized products were studied using differential calorimetry and X-ray crystallography. Similar structures of pseudo-cubic type are found. The spectroscopic study of K3AlH4F2 shows a crystal structure in which coexist Al-F and Al-H links, which has implications for the nature of the hydride ion. ESA

N87-21068# Institut National des Sciences Appliquees, Lyon (France). Lab. de Genie Electrique et Ferroelectricite.
LEAD TITANATES: ELECTROMECHANICAL ANISOTROPIC MATERIALS APPLICABLE TO ELECTROACOUSTIC INSTRUMENTATION Ph.D. Thesis [MATERIAUX ELECTROMECANIQUEMENT ANISOTROPES UTILISABLES DANS L'INSTRUMENTATION ELECTROACOUSTIQUE]
Jean-Jacques Fillot 1986 125 p In FRENCH; ENGLISH summary Sponsored by the Agence Francaise pour la Maitrise de l'Energie, and the Societe Quartz et Silice
(INSA-IDI1-8603; ETN-87-99407) Avail: NTIS HC A06/MF A01

Ferroelectric compounds of the lead titanate type were studied in order to develop industrially feasible products for electroacoustic applications. The ceramic powders were obtained using a modified wet oxalate coprecipitation method. The purified product was thermally treated and ground to 2 sqm/g. The experimental ceramic preparation process is described. The optimized product shows electromechanic characteristics superior to the reference commercial ceramic product (Toshiba C24). ESA

N87-21069# Ecole Centrale de Lyon (France). Lab. de Technologie des Surfaces.
STATE EQUATION OF CONDENSED MATERIALS: PHYSICAL PRINCIPLES AND APPLICATIONS Ph.D. Thesis [EQUATION D'ETAT DES MATERIAUX CONDENSES. PRINCIPES PHYSIQUES ET APPLICATIONS]
Pascal Vinet 1986 182 p In FRENCH Sponsored by Ministere Francais des Relations Exterieures and the Societe Elf-Aquitaine
(ECL-86-15; ETN-87-99421) Avail: NTIS HC A09/MF A01

Analytical expressions are developed to predict in the absence of phase transitions the variations of many thermodynamical parameters. A universal isothermal pressure-volume state equation is determined, whatever the acting cohesion force (ionic, covalent, metallic, or van der Waals). Applications of this model are presented, including vitreous transitions in pressurized lubricants,

the influence of pressure on the shear modulus, and the influence of pressure on melting temperature. ESA

N87-21070# Technische Hogeschool, Eindhoven (Netherlands).
THE ELECTROCATALYSTS OF DIOXYGEN REDUCTION ON TRANSITION METAL CHELATES Ph.D. Thesis
Andreas Martinus T. P. VanderPutten 1986 117 p
(ETN-87-99584) Avail: NTIS HC A06/MF A01

The electrocatalytic properties such as activity, selectivity, and stability of chelates were investigated under well-defined mass-transport conditions, with the rotating ring-disk electrode technique. A comparison between vacuum-deposited films and irreversibly adsorbed monolayers of FePc and CoPc indicates that with vacuum-deposited films only a very small fraction of the film is electrochemically active. A clear relation exists between redox potentials as a function of the pH, and the obtained activity. Compared to the dicofacial dicobalt porphyrins, planar chelate displays reversed selectivity with respect to the solution pH. Activity and selectivity pass through a maximum as a function of pyrolysis temperature. ESA

N87-21071# Rome Univ. (Italy). Dipt. di Fisica.
RAMAN SPECTRA OF WATER IN THE TRANSLATIONAL AND LIBRATIONAL REGIONS. PART 1: STUDY OF THE DEPOLARIZATION RATIO
A. DeSantis, R. Frattini, M. Sampoli, V. Mazzacurati, M. Nardone, M. A. Ricci, and G. Ruocco (Aquila Univ., Italy) 2 Dec. 1986 45 p Submitted for publication
(Preprint-534; ETN-87-99749) Avail: NTIS HC A03/MF A01

Polarized and depolarized Raman spectra of room temperature liquid H2O and D2O were measured up to the bending region. Spectral shapes and depolarization ratios are analyzed in the translational and librational regions. An isotropic spectral component extending over all the investigated frequency range is derived and interpreted in terms of interaction induced mechanisms involving the polarizabilities of the isolated molecule. ESA

N87-21072# Factory Mutual Engineering, Norwood, Mass.
PREDICTION OF FIRE PROPERTIES OF MATERIALS. PART 1: ALIPHATIC AND AROMATIC HYDROCARBONS AND RELATED POLYMERS
A. Tewarson Dec. 1986 61 p Sponsored by NBS
(PB87-140240; NBS/GCR-86/521-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 07D

Combustion behavior of 82 aliphatic and aromatic hydrocarbons and related polymers has been examined for application to fire models. Quantitative predictions have been made for the following fire properties, combustion efficiency and its convective and radiative components; fraction of unconsumed hydrocarbon and polymer vapors present as hydrocarbons; and generation efficiencies of CO2, particulates and mixture of unidentified carbon compounds. GRA

N87-21073# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.
SUPERCRITICAL FLUID CHROMATOGRAPHY OF POLAR ORGANIC COMPOUNDS IN COMBUSTION PARTICULATES Progress Report, 28 Sep. 1984 - 28 Dec. 1985
31 Mar. 1986 52 p Sponsored by Coordinating Research Council, Inc.
(PB87-126645; CRC-APRAC-CAPE-30-81-07) Avail: NTIS HC A04/MF A01 CSCL 07D

A thermionic detector was evaluated for capillary supercritical fluid chromatography of polar nitro-containing polycyclic aromatic compounds (nitro-PAC). Three modes of detector operation were studied. The best performance was obtained using a nitro-selective mode of detection. Although linearity was confined to a narrow range for a given source current, the sensitivity was excellent; 20 pg injected for p-nitrophenol gave a signal-to-noise ratio of 3. Conventional thermionic detection also produced good sensitivity; however, serious baseline drift was observed at high operating temperatures using density programming. A third mode, flame thermionic detection, was not acceptable because of low sensitivity. A number of nitro-PAC were successfully chromatographed using density programming at 101 deg C. GRA

N87-21074# National Bureau of Standards, Gaithersburg, Md. Gas and Particulate Science Div.
GRAVIMETRIC TECHNIQUE FOR THE PREPARATION OF ACCURATE TRACE ORGANIC GAS STANDARDS Interim Report, Jan. - Dec. 1984
G. C. Rhoderick, W. F. Cuthrell, and W. L. Zielinski Jan. 1987 12 p Sponsored by the Environmental Monitoring Systems Lab.
(PB87-145736; EPA-600/4-86-006) Avail: NTIS HC A02/MF A01 CSCL 07D

An accurate procedure based on micro-gravimetry has been used for the preparation of volatile, hazardous organic chemicals in a nitrogen matrix in pressurized gas cylinders at analyte concentrations ranging from 10 ppb to 10 ppm, by mole. In this technique, the organics of interest are individually weighed into separate glass capillary tubes using a micro-analytical balance. The tubes are sealed, and subsequently broken in a fixed line connected to an evacuated cylinder. A known weight of pre-analyzed matrix gas (nitrogen) is then used to pressurize the cylinder, and the concentrations of the organics are calculated on a molar basis relative to the number of moles of the matrix gas. A number of these gravimetric primary mixtures have been prepared and analytically intercompared using gas chromatography (GC) with flame-ionization detection (FID). Excellent agreement has been found between analyte concentration values prepared gravimetrically and concentration values determined by analysis. GRA

N87-21075*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. Ames Research Center.
INFRARED ABSORPTION AND EMISSION CHARACTERISTICS OF INTERSTELLAR PAHs
L. J. Allamandola, A. G. G. M. Tielens, and J. R. Barker (Michigan Univ., Ann Arbor) 1986 20 p Presented at the Interstellar Processes Conference, Jackson, Wyo., 3 Jul. 1986
(Contract DE-FG02-85ER-13442)
(NASA-TM-89287; NAS 1.15:89287; DE87-003375; CONF-8607112-1) Avail: NTIS HC A02/MF A01

The mid-infrared interstellar emission spectrum with features at 3.28, 6.2, 7.7, 8.7 and 11.3 microns is discussed in terms of the Polycyclic Aromatic Hydrocarbon (PAH) hypothesis, which is based on the suggestive, but inconclusive comparison between the interstellar emission spectrum with the infrared absorption and Raman spectra of a few PAHs. The fundamental vibrations of PAHs and PAH-like species which determine the IR and Raman properties are discussed. Interstellar IR band emission is due to relaxation from highly vibrationally excited PAHs excited by ultraviolet photons. The excitation/emission process is described and the IR fluorescence from one PAH, chrysene, is traced. Generally, there is sufficient energy to populate several vibrational levels in each mode. Molecular vibrational potentials are anharmonic and emission from these higher levels will fall at lower frequencies and produce weak features to the red of the stronger fundamentals. This process is also described and can account for some spectroscopic details of the interstellar emission spectra previously unexplained. Analysis of the interstellar spectrum shows that PAHs contain between 20 and 30 carbon atoms are responsible for the emission. DOE

N87-21171# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Physikalische Chemie der Verbrennung.
SIMULTANEOUS TEMPERATURE MEASUREMENTS WITH RAMAN AND CARS IN LAMINAR FLAMES
W. Stricker, W. Kreutner, and Th. Just *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p
(For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21172# United Kingdom Atomic Energy Authority, Harwell (England). Combustion Centre.

CARS THERMOMETRY FOR LOW AND HIGH PRESSURE COMBUSTION SYSTEMS
Douglas A. Greenhalgh *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 26 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21173# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
ACCURATE MEASUREMENTS OF COMBUSTION SPECIES CONCENTRATIONS USING CARS
R. L. Farrow *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 16 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21174# Defence Research Establishment, Ottawa. (Ontario).
NONLINEARITY AND SINGLE SHOT NOISE PROBLEMS IN CARS SPECTROSCOPY
D. R. Snelling, G. J. Smallwood, R. A. Sawchuk, and T. Parameswaran *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 19 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21175# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
APPLICATION OF CARS THERMOMETRY TO A TURBULENT FLAME [APPLICATION DE LA METHODE DRASC A LA MESURE DE LA TEMPERATURE DANS UNE FLAMME TURBULENTE]
Philippe Magre, Pierre Moreau, Gerard Collin, and Michel Pealat *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 19 p In FRENCH; ENGLISH summary (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N87-21076*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE CORROSION MECHANISMS FOR PRIMER COATED 2219-T87 ALUMINUM
Merlin D. Danford and Ward W. Knockemus (Huntingdon Coll., Montgomery, Ala.) Apr. 1987 25 p
(NASA-TP-2715; M-559; NAS 1.60:2715) Avail: NTIS HC A02/MF A01 CSCL 11F

To investigate metal surface corrosion and the breakdown of metal protective coatings, the ac Impedance Method was applied to zinc chromate primer coated 2219-T87 aluminum. The EG&GPARC Model 368 ac Impedance Measurement System, along with dc measurements with the same system using the Polarization Resistance Method, was used to monitor changing properties of coated aluminum disks immersed in 3.5 percent NaCl solutions buffered at pH 5.5 and pH 8.2 over periods of 40 days each. The corrosion system can be represented by an electronic analog called an equivalent circuit consisting of resistors and capacitors in specific arrangements. This equivalent circuit parallels the impedance behavior of the corrosion system during a frequency scan. Values for resistances and capacitances, that can be assigned in the equivalent circuit following a least squares analysis of the data, describe changes occurring on the corroding metal surface and in the protective coatings. A suitable equivalent circuit has been determined which predicts the correct Bode phase and magnitude for the experimental sample. The dc corrosion current density data are related to equivalent circuit element parameters.
Author

N87-21077*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERALLOY RESOURCES: SUPPLY AND AVAILABILITY
Joseph R. Stephens Apr. 1987 47 p Submitted for publication (NASA-TM-89866; E-3305; NAS 1.15:89866) Avail: NTIS HC A03/MF A01 CSCL 11F

Over the past several decades there have been shortages of strategic materials because of our near total import dependence on such metals as chromium, cobalt, and tantalum. In response to the continued vulnerability of U.S. superalloy producers to disruptions in resource supplies, NASA has undertaken a program to address alternatives to the super-alloys containing significant quantities of the strategic materials such as chromium, cobalt, niobium, and tantalum. The research program called Conservation of Strategic Aerospace Materials (COSAM) focuses on substitution, processing, and alternate materials to achieve its goals. In addition to NASA Lewis Research Center, universities and industry play an important role in the COSAM Program. This paper defines what is meant by strategic materials in the aerospace community, presents a strategic materials index, and reviews the resource supply and availability picture from the U.S. point of view. In addition, research results from the COSAM Program are highlighted and future directions for the use of low strategic material alloys or alternate materials are discussed.
Author

N87-21078*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF PLASMA-NITRIDED STEELS
J. Salik (Arizona Univ., Tucson), J. Ferrante, F. Honecy, and R. Hoffman, Jr. (Case Western Reserve Univ., Cleveland, Ohio) 1986 12 p Presented at the Ion Nitriding Conference, Cleveland, Ohio, 15-17 Sep. 1986; sponsored by the American Society for Metals (NASA-TM-89815; E-3442; NAS 1.15:89815) Avail: NTIS HC A02/MF A01 CSCL 11F

The analysis of plasma nitrided steels can be divided to two main categories - structural and chemical. Structural analysis can provide information not only on the hardening mechanisms but also on the fundamental processes involved. Chemical analysis can be used to study the kinetics for the nitriding process and its mechanisms. In this paper preliminary results obtained by several techniques of both categories are presented and the applicability of those techniques to the analysis of plasma-nitrided steels is discussed.
Author

N87-21079# Materials Research Labs., Ascot Vale (Australia).
HIGH-TEMPERATURE OXIDATION OF ALPHA NICKEL-SILICON ALLOYS. MICROSTRUCTURES AND MECHANISMS
J. L. Cocking Apr. 1986 53 p
(AD-A176211; MRL-R-957) Avail: NTIS HC A04/MF A01 CSCL 11/6

The subject of this report is the metallography of a series of nickel and nickel-silicon alloys which have been isothermally oxidized at 1373K in static air for up to 164h. The aim of the study was to determine the mechanisms of oxidation that produced the morphology and microstructures of these oxidized alloys. Pure nickel, after surface preparation by tumbling, oxidizes by outward lattice diffusion of nickel cations and inward gain boundary and other short circuit path diffusion of oxygen. Gain boundary oxides accounted for about 15% of the total weight gained by nickel during oxidation. Additions of 1% and 2% Si to nickel decreased the oxidation rate compared with pure nickel by reacting with the inwardly diffusing oxygen to prevent it diffusing deeply down the grain boundaries of the alloys (the major effect) and by retarding the outward flow of nickel cations (the minor effect). The 3%, 4% and 5% Si alloys form external oxides and oxidize at markedly slower rates than the alloys with lower concentrations of silicon. While the formation of silicon dioxide significantly decreases the isothermal oxidation rate it also causes the oxide scale to spall on cooling because of the difference in thermal expansion coefficients between silicon dioxide and the alloys. Under cyclic oxidation conditions, externally oxidizing NiSi alloys will not be protective unless alloy additions are made to improve the adherence of the oxide scale.
GRA

N87-21080# Battelle Columbus Labs., Ohio.
EFFECT OF MANUFACTURING PROCESSES ON STRUCTURAL ALLOWABLES Final Report, 29 Jun. 1985 - 29 Jul. 1986
Paul E. Ruff Nov. 1986 83 p
(Contract F33615-84-C-5030)
(AD-A176232; AFWAL-TR-86-4120) Avail: NTIS HC A05/MF A01 CSCL 11/6

This report contains the results of tests to determine the effect of manufacturing processes on the mechanical properties of three aerospace materials: Inconel 718 solution treated and aged bar, Inconel 625 annealed bar, and Inconel 625 annealed sheet. Tensile, compression, shear, bearing, and fatigue (notched and unnotched for three stress ratios) properties were obtained. GRA

N87-21081# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
EFFECT OF GRAIN BOUNDARY STRUCTURE ON SENSITIZATION AND CORROSION OF STAINLESS STEEL Annual Technical Report
B. W. Bennett and H. W. Pickering Jan. 1987 38 p
(Contract N00014-84-K-0201)
(AD-A176299) Avail: NTIS HC A03/MF A01 CSCL 11/6

This paper reports on the influence of misorientation angle and structure of a grain boundary on the sensitization and grain boundary corrosion of austenitic and ferritic stainless steels. To establish grain boundary atomic structure, orientation information of the adjacent grains, obtained with the electron backscattering (EBS) technique, was combined with the SEM image of the surface to obtain the orientation of the grain boundary. Modeling of the grain boundary structure was based on ideal crystallography and the coincident site lattice concept. The results support the concepts: (1) of a threshold misorientation angle whose value is a function of the aging time and temperature, below which boundaries are of sufficiently low energy that sensitization does not occur, and (2) of a major role of grain boundary structure in explaining the wide variation in sensitization that occurs in grain boundaries of misorientation angle greater than the threshold value. It was also found that the grain boundary corrosion mechanism is not simply the dissolution of chromimum depleted alloy since the observed groove widths were 10 to 100 times larger than the Cr-profile widths. GRA

N87-21082# Stanford Univ., Calif. Physics Lab.
RESEARCH ON CRYOGENIC VACUUM TUNNELING Annual Report, 1 Aug. 1984 - 31 Jul. 1985
C. F. Quate, S. A. Elrod, A. Bryant, S. Park, and D. Smith Dec. 1986 36 p
(Contract N00014-84-K-0549)
(AD-A176363; GL-4132) Avail: NTIS HC A03/MF A01 CSCL 20/3

Tunneling microscopy has been investigated as a new tool for studying surfaces over a wide range of temperatures. It proved feasible to use tunneling to measure the super-conducting energy gap in a high temperature superconductor. The first time one can monitor the variations in this gap as a function of the spatial position on the surface. GRA

N87-21083# SumX Corp., Austin, Tex.
INHIBITION OF LOCALIZED CORROSION Final Technical Report, 15 Aug. 1983 - 14 Aug. 1986
David W. DeBerry and William S. Clark 10 Dec. 1986 57 p
(Contract DAAG29-83-C-0024)
(AD-A176573; SumX-C83-142; ARO-20049.5-MS) Avail: NTIS HC A04/MF A01 CSCL 11/6

Initial testing has confirmed that N-lauroylsarcosine (NLS) provided protection against pitting in chemically simple systems similar to that observed in more complex SO2 scrubber solutions. Further experimentation resulted in developing a galvanodynamic method for determining the electrochemical pitting parameters in inhibited solutions which has proved quite useful and reliable. The effects of varying a large number of environmental variables on these pitting parameters were investigated using Type 304L stainless steel in inhibited and uninhibited solution. These variables included the chloride concentration, pH (in both buffered and unbuffered solution), inhibitor concentration, solution agitation, and various means of exposing the sample to the inhibitor. Papers are included as appendices: Inhibition of localized corrosion as determined by galvanodynamic method; Inhibition of pitting of type 304L stainless steel by NLS and by surface active compounds; Spontaneous formation of multimolecular layers by pitting inhibitors. GRA

N87-21084# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
DENSIFICATION OF TITANIUM POWDER DURING HOT ISOSTATIC PRESSING
B. K. Lograsso and D. A. Koss Jan. 1987 25 p
(Contract N00014-084-K-0381)
(AD-A176617; TR-4) Avail: NTIS HC A02/MF A01 CSCL 11/6

The densification of spherical and angular titanium powder during hot isostatic pressing (HIP) at 700 C has been studied. The angular powder densified in a manner similar to the spherical powder despite its low initial packing density. Good agreement is found between a model for the HIP of monosize spheres and the experimental data for both spherical and angular powder provided that the transition between the initial stage of densification (contacts between individual particles) and the final stage (compact is a homogeneous solid with isolated pores) occurs at a density of roughly 95% of theoretical. This is consistent with observations of pore microstructure as a function of density. GRA

N87-21085# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
DUCTILE FRACTURE AND RANDOM VERSUS REGULAR HOLE/VOID ARRAYS
P. E. Magnusen, D. A. Koss (Pennsylvania State Univ., University Park), and E. M. Dubensky (Boride Products, Traverse City, Mich.) Feb. 1987 27 p
(Contract N00014-86-K-0381)
(AD-A176627; TR-5) Avail: NTIS HC A03/MF A01 CSCL 20/11

As a physical basis for understanding ductile microvoid fracture, the contrasting behavior of tensile specimens containing random and regular arrays of holes is examined. The results indicate that specimens containing random arrays are less ductile than their regular-array counterparts. The magnitude of this effect depends on the minimum spacing between holes, hole size, and the strain hardening of the material. The experimental results may be understood in terms of the importance of hole/void distribution on a ductile fracture process which is a consequence of both micro- and macroscale shear instabilities. GRA

N87-21086# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
MECHANICAL PROPERTIES OF ELEMENTALLY BLENDED Ti-6Al-4V Final Report, Jun. 1983 - Sep. 1985
H. S. Starrett and Neal R. Ontko Nov. 1986 46 p
(AD-A176640; AFWAL-TR-86-4119) Avail: NTIS HC A03/MF A01 CSCL 11/6

This work was undertaken for the purpose of establishing mechanical properties data on Elementally Blended Titanium/6 Aluminum/4 Vanadium manufactured by an innovative powder metallurgy process. Powders from a master alloy of Aluminum and Vanadium comprising 10 percent of the total weight was blended with commercially available powder from Titanium sponge fines. This blend of powders was then cold pressed, sintered and hot isostatically pressed. Details of the processing are considered proprietary. Comparative costs for this material are substantially less than powders made from pre-alloyed billets such as Rotating Electrode Process (REP) titanium. Four different types of evaluations were preformed on the Titanium alloys/Aluminum/Vanadium alloys, i.e., tension, fatigue (smooth and notched), crack growth rate, and fracture toughness. GRA

N87-21087# Harvard Univ., Cambridge, Mass. Div. of Applied Sciences.
PICOSECOND LASER PULSE INTERACTIONS WITH METALLIC

AND SEMICONDUCTOR SURFACES Final Report, 1 Nov. 1982 - 28 Feb. 1986
Nicolaas Bloembergen and Frans Spaepen 28 Feb. 1986 223 p
(Contract N00014-83-K-0030)
(AD-A176645) Avail: NTIS HC A10/MF A01 CSCL 20/5

Picosecond heating and cooling experiments on silicon, GaAs, graphite and metal surfaces are reported. The surfaces are probed by a picosecond pulse, following the heating pulse, as a function of wavelength, time delay and energy fluence. Picosecond laser-induced transformations of modulated metal energy fluence. Picosecond laser-induced transformations of modulated metal films extend the glass formation range. New glassy alloys have been formed. GRA

N87-21088# SRI International Corp., Menlo Park, Calif.
FRACTURE AND HARDNESS OF SEMICONDUCTOR ALLOYS Annual Technical Report, 1 Sep. 1985 - 31 Aug. 1986
A. Sher, M. VanSchilfgaarde, A.-B. Chen, and M. Berding 5 Nov. 1986 57 p
(Contract F49620-85-K-0023)
(AD-A176800; AFOSR-87-0160TR; ATR-1) Avail: NTIS HC A04/MF A01 CSCL 20/12

We demonstrate that the atomic distribution of constituents in semiconductor alloys is never random. There are always interactions causing correlations; the degree and nature of the correlations depend on which interactions dominate and on the growth condition. We have identified most of the interactions that are expected to cause correlations: electron/electron Coulomb-interactions, and chemical and strain energies. We have developed a method to calculate accurate bond lengths, bond energies, and elastic coefficients for semiconductor compounds. Work has begun to incorporate anisotropicity into the theory of hardness. A calculation of the vacancy formation energies in compounds and dilute alloys has been completed; it will be generalized to concentrated alloys in the future. GRA

N87-21089# Johns Hopkins Univ., Baltimore, Md.
A FUNDAMENTAL UNDERSTANDING OF THE EFFECT OF ALLOYING ELEMENTS ON THE CORROSION RESISTANCE OF RAPIDLY SOLIDIFIED Mg ALLOYS Annual Report, 1 Nov. 1985 - 31 Oct. 1986
Jerome Kruger, Gabrielle G. Long, and Deniol Tanaka 26 Nov. 1986 26 p
(Contract F49620-86-C-0014)
(AD-A176970; AFOSR-87-0028TR) Avail: NTIS HC A03/MF A01 CSCL 11/6

During the first year of this project progress was made in areas that bear on the effect of alloying elements on the corrosion resistance of RSP magnesium alloys, theory of alloying constituents, EXAFS determination of structure of oxide or hydroxide films, and electrochemical evaluation of corrosion resistance. The theoretical studies aided in the selection of constituents of alloying elements for binary alloys used in the complimentary Lockheed AFWAL project (Aluminum, Calcium, Zinc, Lithium, Phosphorus, Chromium). They suggested that elements that promote hydrogen bonding in hydroxide films, Al, Zn, or Boron, should be beneficial. Silicon which produces a surface protective Silicon dioxide shows promise as an alloying element. GRA

N87-21090# Naval Surface Weapons Center, Silver Spring, Md.
EFFECTS OF STRESSES ON THE PHASE TRANSFORMATION OF NITINOL Final Report
David M. Goldstein, Lawrence T. Kabacoff, and John Tydings 2 Apr. 1986 54 p
(AD-A177053; NSWC/TR-86-196) Avail: NTIS HC A04/MF A01 CSCL 11/6

Sequential annealing treatments up to 400 C were performed on a severely cold wrought nickel rich Nickel Titanium (NITINOL) alloy to demonstrate the shape memory performance of the alloy as a function of annealing. The strain recovery was 2.75%. The electrical resistance responses associated with the phase transformations of the specimen, subsequent to the various annealing treatments, are shown and interpreted. Supporting data were obtained on the same alloy for varied annealing cycles by use of a differential scanning calorimeter. Both residual and precipitation-associated stresses have a marked effect on electrical resistance and calorimetric responses during the phase transformation. The changed responses provide the basis for considering the transformation to occur via a metastable rhombohedral (R) structure. The extent to which the R may exist is shown to be related to the residual stresses. The stresses also have a significant effect on the shape memory response. The substantial changes in the range of transition temperatures which can be obtained by various annealing treatments of this slightly nickel rich NITINOL are tabulated. GRA

N87-21091# Pennsylvania Univ., Philadelphia.
FUNDAMENTALS OF HARDENING AND DECOHESION BEHAVIOR IN TIME-DEPENDENT CYCLE DEFORMATION Progress Report, 1 Jan. - 31 Dec. 1986
C. Laird and J. L. Bassani Aug. 1986 8 p
(Contract DE-FG02-85ER-45188)
(DE87-003995; DOE/ER-45188/2) Avail: NTIS HC A02/MF A01

During the last year experimental and theoretical studies have been progressing in parallel. A preliminary project on the cyclic creep fracture of copper and Cu-O and Cu-Pb alloys has been completed by Supersam studies and experiments on acoustic emission to bring out the details of the fracture processes. New experiments using Cu-Pb alloys with lower solute content have been begun. Studies of monotonic latent hardening have also been completed and have been used to understand the monocrystalline hardening law. The following points are emphasized: (1) When deformation begins on any slip system, the hardening rate is initially high and then decreases into easy glide; (2) In Stage 1, the latent hardening on the secondary systems is lower than the self-hardening on the primary; (3) Slip interactions from different systems produce stronger hardening than slip on a single system; (4) If primary slip already exists, the activation of the secondary system causes the self hardening rates of both systems to increase suddenly, but more so on the secondary system; (5) After the sudden increase, the self hardening rate decreases again but in a slower manner than in Stage 1 deformation. Single crystal plastic constitutive equations have been developed that are consistent with these observations. DOE

N87-21092# Oak Ridge National Lab., Tenn.
INVESTIGATION OF CORRELATION OF CARBIDE SIZE AND PERCENTAGE WITH MECHANICAL PROPERTIES OF HIGH STRENGTH LOW ALLOY STEELS
B. J. Shaw Jul. 1986 106 p Prepared in cooperation with Westinghouse Research and Development Center, Pittsburgh, Pa.
(Contract DE-AC05-84OR-21400)
(DE87-004000; ORNL/Sub-85-22006/1) Avail: NTIS HC A06/MF A01

The final report on the DOE Contract 86X-22006C gives the results of statistical analyses and research conducted in the period March 1, 1985 to July 31, 1986. Data generated in the previous DOE Contract (DE-AC05-78ET13513) was combined with carbide analyses performed in this contract. The project was designed to establish the role of composition (Mo,Cr,Mn,Si,C,P) and tempering parameter on a range of steel properties using a statistical design with 32 samples. Models representing the carbides formed as a function of these variables led to constitution diagram for Cr-Mo steels. Further analyses included the role of composition, carbides and the tempering parameter on the yield and ultimate tensile strength, the ductile-brittle transition temperature, the room temperature Charpy impact energy and the threshold stress intensity in a moist H2S environment. DOE

N87-21093# California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
DESIGN OF DUAL PHASE STEELS FOR BARS AND RODS
G. Thomas Aug. 1986 30 p Presented at the International Symposium on Microalloying and New Processing Approaches, Golden, Colo., 8 Jul. 1986 Prepared in cooperation with Lawrence Berkeley Lab., Calif.

(Contract DE-AC03-76SF-00098)
(DE87-003535; LBL-21663; CONF-8607102-1) Avail: NTIS HC A03/MF A01

Low carbon dual phase ferrite-lath martensite composite steels for rods and bars have been designed to meet cold forming requirements. The rounds can be prepared by conventional processing followed by heat treatment or directly on-line in rod or bar mills. The products are fine grained rods or bars which show exceptional promise for applications such as cold drawing to wires without patenting heat treatments, cold heading for fasteners and as reinforcing bars for the construction industry. These steels also have superior ductility, fatigue, low temperature toughness and corrosion resistance compared to conventional mild or high carbon steels. Specific properties can be tailor made by appropriate design of composition and processing to control the composite microstructure and morphology. DOE

N87-21094# Los Alamos National Lab., N. Mex.
STAGE 4 WORK HARDENING IN CUBIC METALS
A. D. Rollett, U. F. Kocks, and R. D. Doherty (Drexel Univ., Philadelphia, Pa.) 1986 16 p Presented at the Fall Meeting of the Metallurgical Society of AIME, Orlando, Fla., 5 Oct. 1986 Prepared in cooperation with Drexel Univ., Philadelphia, Pa.
(Contract W-7405-eng-36)
(DE87-003756; LA-UR-86-4346; CONF-861076-3) Avail: NTIS HC A02/MF A01

The work hardening of fcc metals at large strains is discussed with reference to the linear stress-strain behavior often observed at large strains and known as Stage 4. The experimental evidence shows that Stage 4 is a work hardening phenomenon found quite generally, even in pure fcc metals subjected to homogeneous deformation. A simple model for Stage 4 in pure metals is presented, based on the accumulation of dislocation debris. Experiments are described for large strain torsion tests on four aluminum alloys. The level and extent of Stage 4 scaled with the saturation stress that would represent the end of Stage 3 in the absence of a Stage 4. Reversing the torsion after large prestrains produced transient reductions in the work hardening. The strain rate sensitivity was also measured before and during the transient and found not to vary significantly. The microstructure observed at large strains in an Mg alloy suggest that Stage 4 can occur in the absence of microband formation. Previous proposals for the cause of Stage 4 are reviewed and found to be not supported by recent experimental data. DOE

N87-21095# Massachusetts Inst. of Tech., Cambridge. Corrosion Lab.
OXIDATION BEHAVIOR OF CHROMIUM AND A CHROMIUM-YTTRIUM BINARY ALLOY
C. M. Cotell, K. Przybylski, and G. J. Yurek 1986 25 p Presented at the 169th Meeting of the Electrochemical Society, Boston, Mass., 4 May 1986
(Contract DE-FG02-85ER-45179)
(DE87-003772; CONF-860540-9) Avail: NTIS HC A02/MF A01

The effect of an addition of 0.04 wt % Y on the oxidation behavior of pure Cr at 900 and 1025 C has been investigated. The microstructures and chemical compositions of the Cr2O3 scales formed were studied both parallel and transverse to the oxide/metal interface by SEM, TEM, and STEM. Oxidation kinetics were measured by TGA and the direction of scale growth determined using inert markers. At 900 C, the rate of scale growth, the direction of scale growth and the scale microstructure were unchanged by the addition of 0.04 wt % Y to Cr. At 1025 C, the direction of scale growth and scale microstructure were unchanged by the addition of 0.04 wt % Y, but the rate of oxidation was reduced by a factor of six. A model for the development of the microstructures of chromia scales formed on Cr and Cr-0.04 wt % Y is presented, and the effect of yttrium on the rate of growth of chromia at 900 and 1025 C is discussed. DOE

N87-21096# Witwatersrand Univ., Johannesburg (South Africa).
A LITERATURE REVIEW OF THE PROPERTIES AND USES OF VANADIUM IN ENGINEERING ALLOYS AND OF VANADIUM CARBIDE
R. Paton and S. Luyckx 29 Aug. 1986 44 p
(DE87-900462; MINTEK-M-270) Avail: NTIS (US Sales Only) MF A01

The main use of vanadium is in the manufacture of alloy steels, particularly the high-strength low-alloy types. Apart from its use in non-ferrous alloys, the consumption of vanadium outside the steel industry is very limited. Vanadium is little used in stainless steels, and it is recommended that research should be undertaken towards the development of a general-purpose ferritic stainless steel containing both molybdenum and vanadium. Vanadium-based cemented carbides can replace alloys based on tungsten carbide in applications where resistance to mechanical and thermal shock is not an important criterion. Research should be started in South Africa in the field of vanadium carbide coatings. DOE

N87-21097# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
STRESS CORROSION CRACKING AND METAL-INDUCED EMBRITTLEMENT: COMPARATIVE STUDIES OF LOCAL CHEMISTRIES Progress Report, 1 Sep. 1986 - 15 Jan. 1987
L. A. Heldt and C. L. White Jan. 1987 4 p
(Contract DE-FG02-86ER-45255)
(DE87-004300; DOE/ER-45255/1) Avail: NTIS HC A02/MF A01

This parallel study of stress corrosion cracking (SCC) and metal-induced embrittlement (MIE) is directed toward understanding a number of interesting and unexplained similarities between these two phenomena. Initial experiments are focusing on the role of local chemistries at the crack tips, both in the environment and along the microstructural fracture path in the cracked material. DOE

N87-21098# Oak Ridge National Lab., Tenn.
EFFECT OF ALUMINUM ADDITION ON DUCTILITY AND YIELD STRENGTH OF Fe3Al ALLOYS WITH 0.5 WT % TiB2
C. G. McKamey, J. A. Horton, and C. T. Liu Dec. 1986 7 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986
(Contract DE-AC05-84OR-21400)
(DE87-004621; CONF-861207-46) Avail: NTIS HC A02/MF A01

Studies have been conducted of the mechanical properties of FeAl alloys containing 24 to 30 at. % Al, to which 0.5 wt % TiB was added for grain refinement. In tensile tests conducted at room temperature, it has been found that, as the aluminum content is increased, the yield strength decreases sharply from 760 to 310 MPa. The decrease in yield strength is accompanied by a four-fold increase in room-temperature ductility. Ordered iron aluminides (containing no disordered phase) showed a clear increase in yield strength with temperature above 300 C. Their strength reached a maximum around 600 C, above which it decreased sharply. All these results are discussed and correlated with stability of superlattice dislocations as a function of aluminum content. DOE

N87-21099# Argonne National Lab., Ill.
TECHNICAL BASIS FOR NORMAL WATER CHEMISTRY GUIDLINES:: REVIEW OF LABORATORY STUDIES OF WATER CHEMISTRY EFFECTS ON SCC (STRESS CORROSION CRACKING)
T. F. Kassner, P. S. Maiya, J. Y. Park, W. E. Ruther, W. J. Shack, and W. K. Soppet Oct. 1986 11 p Presented at the Seminar on BWR Corrosion, Chemistry, and Radiation Control, Palo Alto, Calif., 10 Nov. 1986
(Contract W-31109-eng-38)
(DE87-004701; CONF-8611120-1) Avail: NTIS HC A02/MF A01

The influence of dissolved oxygen, hydrogen, and various impurity anions on the stress corrosion cracking (SCC) susceptibility of sensitized Type 304 stainless steel (SS) and alternative piping materials such as Types 316NG and 347NG SS is being investigated in constant-extension-rate-tensile (CERT) tests and in cyclic loading experiments on fatigue precracked fracture-mechanics-type specimens at 289 C. In these experiments, the crack growth behavior of the materials is being correlated with the impurity

concentration and the electrochemical potentials of Type 304 SS and platinum electrodes in simulated BWR normal operating environments (approx. 200 to 300 ppb oxygen and < 100 ppb of various oxyanions of halides added as acid or salts, at a total conductivity of <1 S/cm). DOE

N87-21100# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
MICROSTRUCTURAL RESPONSE OF RAPIDLY SOLIDIFIED 304 STAINLESS STEEL POWDER TO THREE CONSOLIDATION TECHNIQUES
D. V. Miley, J. E. Flinn, and G. L. Fletcher 1986 16 p Presented at the International Metallographic Society Conference on Microstructural Science, Boston, Mass., 3 Aug. 1986
(Contract DE-AC07-76ID-01570)
(DE87-000439; EGG-M-18286; CONF-8608153-2) Avail: NTIS HC A02/MF A01

Some of the characteristics of rapidly solidified metals, such as reduced chemical segregation and extremely fine grain size, can result in improved material properties and performance. However, these same characteristics present a challenge to the metallographer examining the microstructures of these materials, and frequently more than one technique is required to characterize the features present. This paper describes the vastly different microstructure produced in centrifugally atomized 304 stainless steel powder after consolidation by three different processes: hot isostatic pressing, extrusion, and explosive consolidation. Characterization of microstructural features depended upon a combination of optical, scanning electron, and transmission electron techniques. DOE

N87-21101# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
PROCESSING AND PROPERTIES OF POWDER METALLURGY NI(SUB 3)AL-CR-ZR-B FOR USE IN OXIDIZING ENVIRONMENTS
V. K. Sikka, C. T. Liu, and E. A. Loria (Cyclops Corp., Bridgeville, Pa.) Oct. 1986 11 p Presented at the American Society of Metals Materials Week, Lake Buena Vista, Fla., 6 Oct. 1986 Prepared in cooperation with Cyclops Corp., Bridgeville, Penn.
(Contract DE-AC05-84OR-21400)
(DE87-001699; CONF-861063-1) Avail: NTIS HC A02/MF A01

The addition of Cr to B-doped Ni3Al in small ingots used for alloy development alleviates dynamic embrittlement, as exemplified by low tensile elongation and intergranular fracture, on testing in air at 600 C. Powder metallurgy (PM) technology is advantageous to properties due to improved microstructure from rapid solidification, and its effectiveness was studied in the up-scale production of four heats of this intermetallic compound with 8 Cr, 0.8 or 1.8 Zr, and 0.02 B (wt %). Sheet derived from a cold-rolling and annealing sequence on extruded product had a satisfactory level of ductility in tensile tests conducted in air within the critical 400 to 800 C range. The processing parameters for hot workability of the PM product were established via a number of different strain rate tensile tests in air at temperatures up to 1100 C. Superplastic behavior presented the opportunity for fabrication of a forged shape by hot isothermal forging. Preliminary forging of cylinders cut from the extruded bars revealed no peripheral cracking in 60% compression tests at strain rates of 0.1 to 0.5/min at 1100 C. Successful isothermal forging of a prototype turbine disk directly from extruded bar stock in a closed die at 1100 C and strain rate of 0.5/min was demonstrated, and the microstructure and mechanical properties were at least equal to those of PM sheet and bar products. DOE

N87-21102# Hanford Engineering Development Lab., Richland, Wash.
EFFECTS OF IRRADIATION ON THE FRACTURE TOUGHNESS OF ALLOY 718 PLATE AND WELD
W. J. Mills May 1986 37 p Presented at the Effects of Radiation on Materials, Berkeley, Engl., 7 Apr. 1987
(Contract DE-AC06-76FF-02170)
(DE87-004345; HEDL-SA-3527-FP; CONF-870480-1) Avail: NTIS HC A03/MF A01

The effect of fast-neutron irradiation on the J/sub Ic fracture toughness of Alloy 718 plate and weld was characterized at 427 C using single- and multiple-specimen R-curve techniques. Two heat treatments were employed: the conventional ASTM B637 precipitation heat treatment (CHT) and a modified heat treatment (MHT) designed to improve the impact toughness of Alloy 718 welds. In the unirradiated and irradiated conditions, the fracture resistance of the MHT materials was consistently higher than that for their CHT counterparts. Irradiation significantly reduced the J/sub Ic and tearing modulus values for the plate and weld in both heat-treated conditions with saturation occurring at relatively low neutron exposures (below 8 dpa). The CHT base metal and weld exhibited saturation J/sub Ic levels of 31 and 21 kJ/sq m, respectively; a saturation level of 52 KJ/sq m was obtained for both the MHT wrought product and weld metal. Electron fractographic examination revealed that irradiation damage induced a transition from microvoid coalescence to channel fracture, which was associated with localized separation along planar slip bands. The effects of microstructure and operative fracture mechanisms were related to the fracture resistance of unirradiated and irradiated materials. DOE

N87-21103# Michigan State Univ., East Lansing.
DYNAMIC RECRYSTALLIZATION DURING HIGH TEMPERATURE LOW CYCLE FATIGUE OF NICKEL Progress Report, 1 Jun. 1986 - 31 May 1987
G. Gottstein Jan. 1987 77 p
(Contract DE-FG02-85ER-45205)
(DE87-006152; DOE/ER-45205/2) Avail: NTIS HC A05/MF A01

Dynamic recrystallization during high temperature low cycle fatigue (LCF) of Ni and its effect on mechanical properties was investigated. Dynamic recrystallization was found in polycrystals, even at total strain amplitudes as low as 0.004. Dynamic recrystallization was nucleated at grain boundaries. No dynamic recrystallization could be initiated in a single crystal with 1% strain amplitude up to 300 cycles. Concurrent grain boundary migration and sliding was observed. These processes lead to considerable grain growth, while dynamic recrystallization tends to refine the grain size. The cyclic hardening curve invariably reveals a maximum, which cannot be attributed solely to dynamic recrystallization, because of the softening due to grain boundary realignment and grain coarsening. B-doped NiAl gave results similar to Ni. The kinetics and microstructural development of deformed NiAl was studied. The development of the deformation structure is similar to Ni but the texture development is quite different. Recrystallization was observed to start early at deformation inhomogeneities, but the recrystallization kinetics are fairly slow. A feasibility study regarding the use of synchrotron radiation for the determination of grain boundary distributions was successful. DOE

N87-21104# California Univ., Berkeley.
DESIGN OF LOW CARBON DUAL-PHASE STEELS FOR HIGH STRENGTH WIRE Ph.D. Thesis
J. H. Ahn Aug. 1986 148 p
(Contract DE-AC03-76SF-00098)
(DE87-006169; LBL-22591) Avail: NTIS HC A07/MF A01

Alloy design considerations were assessed to develop a dual-phase steel suitable for cold drawing into high strength wire. Effects of metallurgical variables such as martensite particle size, shape, volume fraction and ferrite grain size on controlling the strength-ductility balance were described. The dual-phase steel Fe-2% Si-0.1% C, developed according to design guidelines, was found to be the most promising material for high strength wire application. This steel could be continuously drawn to strength levels found in commercial high carbon pearlitic wires without any intermediate patenting treatments during the drawing process, resulting in reductions of production cost and operation complexity. The attractive properties are attributed to the fine, fibrous and disconnected lath martensite particles in a fine ferrite matrix. This microstructure can be produced by austenitizing and quenching to form 100% martensite, followed by two phase annealing and subsequent quenching or in the as-rolled condition by rolling in the two phase region and quenching after controlled deformation

in the austenite region. The quench after two-phase annealing or finish rolling should be as rapid as possible to prevent austenite pool shrinkage or decomposition prior to transformation to martensite. DOE

N87-21105# Pacific Northwest Labs., Richland, Wash.
GRAIN BOUNDARY COMPOSITION EFFECTS ON ENVIRONMENTALLY INDUCED CRACKING OF ENGINEERING MATERIALS
S. M. Bruemmer Sep. 1986 14 p Presented at the Corrosion 87, San Francisco, Calif., 9 Mar. 1987
(Contract DE-AC06-76RL-01830)
(DE87-006405; PNL-SA-14370; CONF-870314-9) Avail: NTIS MF A01

There is now clear evidence that intergranular stress corrosion cracking (SCC) and hydrogen embrittlement (HE) of engineering materials depend on grain boundary composition. Two examples are used to illustrate this interrelationship: (1) SCC of austenitic stainless steel in high-temperature water, and (2) HE of NiCrMoV rotor steels in acidic solutions. Grain boundary compositions are characterized by analytical electron microscopy and scanning Auger electron spectroscopy. Environmental cracking susceptibility is indicated by slow-strain-rate tests in appropriate aqueous environments. Direct correlations are documented between measured grain boundary compositions and environmental cracking. The ability to establish these types of correlations enables diagnosis of embrittlement susceptibility and helps identify methods to control or eliminate embrittlement by bulk chemistry or processing modifications. DOE

N87-21106# Oak Ridge National Lab., Tenn.
CREEP CAVITATION IN A NICKEL ALUMINIDE
J. H. Schneibel and L. Martinez 1987 14 p Presented at the 3rd International Conference on Creep and Fracture of Engineering Materials and Structures, Swansea, England, 5 Apr. 1987
(Contract DE-AC05-84OR-21400)
(DE87-004392; CONF-870447-2) Avail: NTIS HC A02/MF A01

Intergranular cavities formed during creep of a nickel aluminide (Ni-23.5 Al-0.5 Hf-0.2 B, at. %) have been studied as a function of creep time and strain. Cavity growth rates as a function of cavity size have been evaluated from metallographically determined size distributions. The observed growth rates and cavity thicknesses are in order of magnitude agreement with a model of creep-enhanced crack-like diffusive growth, which we have developed recently. However, whereas our model predicts that the growth rate decreases with increasing cavity diameter, the opposite trend is observed experimentally. It is likely that coalescence is responsible for this discrepancy. Cavity growth in the investigated nickel aluminide also exhibits a grain size dependence. Cavities in large-grained (approx. 210 microns) material were observed to grow slower than those in fine-grained (approx. 50 microns) material. This result is explained by the comparatively low creep rate of the large-grained material. DOE

N87-21107# Fracture Control Corp., Goleta, Calif.
DUCTILE IRON DATA BASE. CORRELATIONS BETWEEN MICROSTRUCTURE AND FRACTURE TOUGHNESS: BACKGROUND DOCUMENT FOR DRAFT ASTM DUCTILE IRON SPECIFICATION
P. McConnell and P. Lombrozo Feb. 1987 71 p Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE87-006010; SAND-86-7163) Avail: NTIS MF A01

A computer data base was generated to relate ductile iron fracture toughness with microstructural parameters, chemistry, and mechanical properties. Such relationships are considered necessary before a ductile iron material specification can be generated for spent nuclear fuel containers. Although scatter exists in the available data and more data are desirable, tentative conclusions can be drawn. In particular, ductile iron with high ferrite content (greater than 80%) and spherical graphite nodules shows relatively high fracture toughness values suggesting its suitability for use in spent nuclear fuel casks. A material specification based upon nodule count (or the inversely related nodule spacing) may ensure a minimum fracture toughness in ductile iron. Increasing nodule spacing (decreasing count) increases the fracture toughness. Other relationships between mechanical properties and microstructure/chemistry are evaluated. DOE

N87-21108# Rockwell International Corp., Golden, Colo.
TITANIUM-BERYLLIUM RESIDUAL STRAIN ANALYSIS: ROLE OF DEPOSITION VARIABLES ON TEXTURE AND STRENGTH
A. F. Jankowski 21 Nov. 1986 15 p
(Contract DE-AC04-76DP-03533)
(DE87-006197; RFP-3926) Avail: NTIS HC A02/MF A01

The state of stress in vapor deposited films is dependent upon several deposition variables, such as temperature, flux rates, and background vacuum, as well as materials selected for the coating and the substrate. The state of stress and strain at the coating-substrate interface influences the adhesive strength. The dependence of the adhesive strength upon the texture of the deposited coating and the state of strain at the interface are examined with respect to the deposition variables of flux rate and substrate temperature. Titanium coated beryllium substrates are analyzed by X-ray diffraction and mechanical testing. DOE

N87-21109# Technical Research Centre of Finland, Espoo. Metals Lab.
ON THE CORRELATION OF HARDNESS WITH TENSILE AND YIELD STRENGTH
Pertti Auerkari Jul. 1986 23 p Sponsored by the Japanese Ministry of Education, and the Finnish Ministry of Trade and Industry
(VTT-416; ISBN-951-38-2650-5; ISSN-0358-5077; ETN-87-99359)
Avail: NTIS HC A02/MF A01

The relations between hardness and tensile properties of common metals are reviewed. Using the Cahoon formula, the correlation of hardness with tensile strength is generally good (difference less than 10%) provided that the strain hardening exponent n is known or can be estimated. The corresponding correlation with yield strength is less impressive but still reasonable (difference less than 15%) if the value of n remains approximately constant and characterizes the original material. Less satisfactory correlations may be obtained for multiphase materials or materials showing microstructural changes during plastic straining. Reliable determination of n from hardness-type indentation is not easy, and seems especially difficult to obtain from the same standard type hardness indentation which is used for hardness measurement. ESA

N87-21110# Technical Research Centre of Finland, Espoo. Metals Lab.
FRACTURE PROPERTIES OF FERRITIC, FERRITIC-PEARLITIC, PEARLITIC AND BAINITIC NODULAR CAST IRONS
Tero Oeberg and Kim Wallin Sep. 1986 44 p Sponsored by the Finnish Ministry of Trade and Industry, the Nordic Industry Foundation, Kymi-Stroemberg Oy, Rosenlew Oy, and Valmet Oy
(VTT-430; ISBN-951-38-2665-1; ISSN-0358-5077; ETN-87-99360)
Avail: NTIS HC A03/MF A01

Thickness and temperature effects on the fracture toughness parameters of nodular cast irons were tested. Fatigue parameters were also examined. Although the microstructure forms the basis of the fracture behavior of nodular cast irons, it is found that deviations in fracture properties reported in the literature are due to insufficient testing conditions. ESA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N87-21111* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

QUASI-CONTAINERLESS GLASS FORMATION METHOD AND APPARATUS Patent
Robert J. Naumann, inventor (to NASA) and Edwin C. Ethridge, inventor (to NASA) Issued 31 Mar. 1987 10 p Filed 5 Dec. 1985 Supersedes N86-21684 (24 - 12, p 1926
(NASA-Case-MFS-28090-1; US-Patent-4,654,065;
US-Patent-Appl-SN-805012; US-Patent-Class-65-2;
US-Patent-Class-65-13; US-Patent-Class-65-134;
US-Patent-Class-65-136) Avail: US Patent and Trademark Office CSCL 11B

Glass rods or fibers are prepared from a polycrystalline rod by heating a short section of the rod in a first furnace to form a molten zone of the rod, heating a second short section of the rod in a second furnace to form a second molten zone and gradually moving the furnaces apart from one another to form an elongated molten float zone, which is cooled in its midsection to produce a glass rod between the molten zones. In another embodiment a single moving furnace assembly and a precursor rod with compositional gradient sections, are used, and the moving furnace traverses the rod so that the molten portion is drawn out to a degree whereby a fiber of ultrapure glass is formed.
Official Gazette of the U.S. Patent and Trademark Office

N87-21112* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROCESS FOR PREPARING PHTHALOCYANINE POLYMER FROM IMIDE CONTAINING BISPHTHALONITRILE Patent
Bappalige N. Achar, inventor (to NASA) (National Academy of Sciences - National Research Council, Washington, D. C.), George M. Fohlen, inventor (to NASA), and John A. Parker, inventor (to NASA) Issued 10 Mar. 1987 9 p Filed 12 Jul. 1985 Supersedes N86-19461 (24 - 10, p 1560)
(NASA-Case-ARC-11511-2; US-Patent-4,649,189;
US-Patent-Appl-SN-754362; US-Patent-Class-528-220;
US-Patent-Class-528-229; US-Patent-Class-528-322;
US-Patent-Class-528-327; US-Patent-Class-528-331;
US-Patent-Class-528-362) Avail: US Patent and Trademark Office CSCL 11B

Imide-linked bisphthalonitrile compounds are prepared by combining a dicyano aromatic diamine and an organic dianhydride to produce an amic acid linked bisphthalonitrile compound. The amic acid linked bisphthalonitrile compound is dehydrocyclized to produce the imide-linked bisphthalonitrile compounds. The imide-linked bisphthalonitrile compounds may be polymerized to produce a phythalocyanine polymer by heating the imide-linked bisphthalonitrile compound, either alone or in the presence of a metal powder or a metal salt. These compounds are useful in the coating, laminating and molding arts. The polymers are useful in composite matrix resins where increased fire resistance, toughness and resistance to moisture are required, particularly as secondary structures in aircraft and spacecraft.
Official Gazette of the U.S. Patent and Trademark Office

N87-21113# Texas Technological Univ., Lubbock. Glass Research and Testing Lab.
FAILURE STRENGTHS OF LAMINATED GLASS UNITS Final Report
P. L. Reznik and J. E. Minor Oct. 1986 84 p
(PB87-118873; TTU-IDR-80D) Avail: NTIS HC A05/MF A01 CSCL 11C

Laminated glass units have gained popularity as an architectural glazing product. Their safety and versatility are being used to satisfy many design situations. This usage has established a need for increased understanding of the behavior of laminated glass units subjected to common loadings. The report advances the understanding of laminated glass unit behavior under uniform lateral pressure. The report addresses failure strengths of laminated glass units under different physical and environmental conditions and compares these strengths with the failure strengths of comparably sized monolithic glass plates. GRA

N87-21114# Materials Quality Assurance Directorate, London (England). Technical Support Materials Center.
A HANDBOOK OF (SUP)13 C NMR SPECTRA OF ALKYD PAINT BINDERS AND ASSOCIATED MATERIALS
G. L. Marshall Dec. 1985 40 p
(MQAD-TP-911; BR-98528; ETN-87-99453) Avail: NTIS Avail: NTIS HC A03/MF A01

Oils and alkyds encountered in paint systems were investigated. Spectra from air drying and stoving systems are presented. The characteristic features of each type of material are discussed.ESA

N87-21115# Minnesota Univ., Minneapolis.
NETWORK POLYMERS FORMED UNDER NONIDEAL CONDITIONS Final Report, 1 Oct. 1983 - 30 Sep. 1986
Christopher W. Macosko Dec. 1986 75 p
(Contract DAAG29-83-K-0149)
(AD-A176408; ARO-20678.15-CH) Avail: NTIS HC A04/MF A01 CSCL 07/4

Formation of polymer networks are discussed under nonideal conditions. The work accomplished falls into three categories: (1) probability models for determining molecular weight relations and network parameters, (2) study of epoxy systems, and (3) study of vinyl-divinyl systems. The general theoretical work on probability models has comprised the following: (1) the crosslinking of chains with arbitrary length and site distribution, (2) A3 and B2 step polymerization with cycles, and (3) anionic, network-forming systems. Several nonidealities in epoxy systems have been and are being analyzed. Substitution effects and secondary reactions in epoxy-amine systems have been characterized and incorporated into a branching theory, and good agreement with experimental results obtained. Another problem in these systems is the effect of vitrification, so the variation of Tg with conversion has been studied for DGEBA-DDM and epoxy-novolac systems. In vinyl/divinyl systems, the formation of loops and the reduction in pendant double bond reactivity have been studied. A kinetic model was developed to predict the conversion of pendant double bonds to crosslinks and cycles, that information being employed in a branching theory. Good viscosity correlations were obtained. Further theoretical studies of cyclization were initiated as groundwork for systems for which cyclization may play an even larger role (e.g., in the formation of microgels). GRA

N87-21116# Washington Univ., St. Louis, Mo.
ULTRASONIC CURE CHARACTERIZATION OF EPOXY RESINS: CONSTITUTIVE MODELING
E. J. Tuegel and H. T. Hahn Oct. 1986 16 p
(Contract N00014-85-K-0795)
(AD-A176661) Avail: NTIS HC A02/MF A01 CSCL 11/9

The use of ultrasound to monitor the cure of epoxy resins has been reported in the literature. It has been observed that the speed of the ultrasonic wave increases as the resin cures while the attenuation first increases and then decreases. These changes have been qualitatively explained in terms of the changes in viscosity. In order to use ultrasonic technique to characterize property changes during cure, quantitative relationships between changes in the wave speed and attenuation on the one hand and changes in the elastic modulus and viscosity on the other must be established. Ultrasonic data available in the literature were converted to complex moduli within the framework of the theory of wave propagation in linear viscoelastic materials. Simple spring-dashpot combinations were then used to develop a constitutive model, and the pertinent elastic moduli and viscosities were obtained from the complex moduli. The elastic moduli inferred from the complex moduli were found to agree well with the values measured by mechanical testing. GRA

N87-21117# Pennsylvania State Univ., University Park. Materials Research Lab.
INVESTIGATIONS INTO THE ORIGINS OF THE PHYSICAL STRUCTURE OF THIN FILMS Annual Technical Report, 1 Jul. 1985 - 30 Jun. 1986
Russell Messier 16 Oct. 1986 72 p
(Grant AF-AFOSR-0149-84)
(AD-A176943; AFOSR-87-0159TR) Avail: NTIS HC A04/MF A01 CSCL 07/4

Thin film morphology often plays a critical role in the large variation in film properties with varying film preparation conditions. The research being carried out under this grant has been directed toward establishing a quantitative link between preparation property relations. A central part of this work has been to develop a fractal model of the general cauliflower-like morphology that pervades films prepared under low adatom mobility conditions. The general approach has been to attack this problem from a number of different angles. GRA

N87-21118# Naval Research Lab., Washington, D. C.
ULTIMATE TENSILE STRENGTH OF PITCH-BASED CARBON FIBERS Interim Report
Richard K. Everett 31 Dec. 1986 16 p
(AD-A176955; NRL-MR-5883) Avail: NTIS HC A02/MF A01 CSCL 11/4

Histograms of the average diameter, fiber breaking load and ultimate tensile strength were determined for as-received VSB-320 grade, Thornel P-type carbon fiber. The mean fiber diameter and the mean ultimate tensile strength were determined to be 10.4 micrometer and 2.0 GPa (290 ksi), respectively, in good agreement with manufacture's property data. Kinked fibers having larger diameters, lower strength and coatings of a substance tentatively identified as the sizing comprised approximately 15 percent of the fiber in the tow. Washing fibers in distilled water increases both their diameter and the average breaking load. GRA

N87-21119# Northeastern Univ., Boston, Mass. Dept. of Physics.
SUPERLATTICE EFFECTS IN GRAPHITE INTERCALATION COMPOUNDS Report, 1 Oct. 1985 - 31 Mar. 1986
R. S. Markiewicz 15 Apr. 1986 24 p
(Contract F49620-82-C-0076)
(AD-A177009; AFOSR-87-0104TR) Avail: NTIS HC A02/MF A01 CSCL 20/3

Research is continuing into the Landau level condensation of a dense two-dimensional hole gas in a strong magnetic field, recently discovered in long-chain carbon bromine. The series of phase transitions, periodic in (inverse) magnetic field, produce a domain phase which is an ideal candidate for the study of nonlinear soliton (domain wall) dynamics. Study of a.c. coupling to a normal mode oscillation (bending mode) of the domain wall indicates chaotic behavior following a quasiperiodic route. A simple model is capable of explaining the observed lineshape of the susceptibility oscillations and unambiguously determining the Landau level bandwidth -- thereby pinpointing the field at which the strong two-dimensional limit occurs (no Landau level overlap). As the sample thickness is decreased, it is predicted that the system will transform into a charged-domain phase closely analogous to the quantum Hall effect. GRA

N87-21120# SRI International Corp., Menlo Park, Calif.
ORDERED POLYMERS FOR SPACE APPLICATIONS Final Technical Report, 1 Jun. 1983 - 30 Apr. 1985
James F. Wolfe Dec. 1986 437 p
(Contract F49620-83-K-0036)
(AD-A177108; AFOSR-87-0017TR) Avail: NTIS HC A19/MF A01 CSCL 22/2

SRI has developed a novel poly(phosphoric acid) (PPA) polymerization method and extended the basic techniques of this method to numerous possible initial monomer mixtures having a wide variety of phosphorus pentoxide contents. The polymerization method, called the adjustable P2O5 content method, allows the preparation of a broad family of polymers at high concentration and allows the realization of the following advantages over state-of-the-art methods: high molecular weight; fast polymerization rate; and direct preparation of a liquid crystalline solution having a high concentration of the high molecular weight polymer. The method was expanded to solvents beyond simple PPAs to include solvents containing a methanesulfonic acid P2O5 and similar strong acids. The concept of using higher surface-to-volume ratio reactors for preparing the initial monomer solution, that is, the dehydrochlorinated solution of the first monomer, is described. The striking differences in reaction rate and the attainable molecular weight of the condensation polymer of polymerizations that are conducted in the liquid crystalline (nematic) phase compared with those conducted in the isentropic phase give support to the concept of a mesophase-mediated polymerization phenomenon. GRA

N87-21121# Dayton Univ., Ohio.
ASSESSMENT OF REMAINING LUBRICANT LIFE Final Report, 15 Nov. 1983 - 15 Dec. 1985
Robert E. Kauffman and Wendell E. Rhine Nov. 1986 385 p
(Contract F33615-83-C-2317)
(AD-A177186; UDRI-TR-86-14; AFWAL-TR-86-2024) Avail: NTIS HC A17/MF A01 CSCL 11/8

An investigation was conducted in order to develop a remaining lubricant life assessment test (RLLAT) for MIL-L-7808 lubricating oils. The RLLAT would enable the Air Force to reduce material and labor costs by eliminating scheduled oil changes. In Task 1, analytical procedures capable of performing remaining lubricant life (RLL) assessments of MIL-L-7808 lubricating oils were identified and evaluated. Of the numerous analytical procedures identified in Task 1, procedures based on cyclic voltammetry, differential scanning calorimetry (DSC), and chemical stressing were determined to be the best candidates for development into a RLLAT. In Task 2, a RLLAT was developed from the reductive-cyclic voltammetric (RCV) technique and a microcomputer based data acquisition system. The RLLAT based on the RCV technique and data acquisition system (RLLAT-RCV) was rapid (total analysis time less than 30 seconds), inexpensive (less than $3,000), and base-level in operation and RLL assessments. The development of RLLAT from the DSC techniques were limited by the high instrumental costs (greater than $20,000). In Task 3, the applicability of the RLLAT-RCV to different types of lubricating was demonstrated. GRA

N87-21122# Oak Ridge National Lab., Tenn.
INTRODUCTION AND STATUS OF THE CERAMIC TECHNOLOGY FOR ADVANCED HEAT ENGINES PROJECT
D. R. Johnson and R. B. Schulz Oct. 1986 4 p Presented at the Automotive Technology Development Contractors' Coordination Meeting, Dearborn, Mich., 27 Oct. 1986 Prepared in cooperation with DOE, Washington, D.C.
(Contract DE-AC05-84OR-21400)
(DE87-004403; CONF-861002-4) Avail: NTIS HC A02/MF A01

The Ceramic Technology for Advanced Heat Engines Project of the Advanced Materials Development Program was initiated in 1983 to meet the ceramic materials technology requirements of the companion DOE engine programs, the Advanced Gas Turbine Program, and the Heavy Duty Transport (low heat rejection heavy duty diesel) Program. Our goal is the technology base that will allow private industry to supply reliable and cost effective ceramics for applications in these advanced engines. Accordingly, our program includes the following objectives: improved and new synthesis and fabrication technology to improve the reliability of monolithic ceramics, toughened ceramic composites, and ceramic coatings; improved and new joining technology required for reliable ceramic attachments; an understanding of the physical and chemical mechanisms that control the friction and wear of ceramic materials and coatings under heat engine operating conditions; and identification and understanding of the mechanisms that control the long-term mechanical reliability of structural ceramics in advanced engine environments. DOE

N87-21123# Argonne National Lab., Ill.
DEVELOPMENT OF NUCLEAR MAGNETIC RESONANCE IMAGING TECHNIQUES FOR CHARACTERIZING GREEN-STATE CERAMIC MATERIALS
J. L. Ackerman, W. A. Ellingson, J. A. Koutcher, and B. R. Rosen Oct. 1986 10 p Presented at the Nondestructive Characterization of Materials, Montreal, Canada, 21 Jul. 1986 Prepared in cooperation with Massachusetts General Hospital, Boston
(Contract W-31-109-eng-38)
(DE87-004987; CONF-860763-5) Avail: NTIS MF A01

The overall objective is to develop NMR methods for nondes-

tructive evaluation in ceramics processing. This report describes preliminary research directed toward the use of NMR for nondestructively mapping porosity and internal voids in green-state bodies. Some future extensions of this work include the imaging of pore size distribution, and the imaging of binders, plasticizers and other components of the test sample. The investigators have shown it is possible to nondestructively image the internal volumes in a green-state ceramic body using filler fluids to provide NMR signal intensity. Features on the order of 300 microns can be detected in a field of view of 100 mm, and porosity may be imaged and measured as a fraction of maximum signal intensity. With improvements of the NMR apparatus specifically targeted to materials science applications, much higher resolution can be achieved: resolution approaching 10 microns has recently been reported for very small biological samples. In addition to developing NMR probes optimized for ceramics processing development, we are proceeding to design experimental methods which employ cross-polarization techniques to image the organic phase directly. DOE

N87-21124# Los Alamos National Lab., N. Mex.
ANALYSIS OF PICOSECOND PULSED LASER MELTED GRAPHITE
J. Steinbeck, G. Braunstein, J. Speck, M. S. Dresselhaus, C. Y. Huang, A. M. Malvezzi, and N. Bloembergen 1986 10 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986 Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge; Harvard Univ., Cambridge, Mass.
(Contract W-7405-eng-36)
(DE87-003755; LA-UR-86-4339; CONF-861207-45) Avail: NTIS HC A02/MF A01

A Raman microprobe and high resolution TEM have been used to analyze the resolidified region of liquid carbon generated by picosecond pulse laser radiation. From the relative intensities of the zone center Raman-allowed mode for graphite at 1582 cm(-1) and the disorder-induced mode at 1360 cm(-1), the average graphite crystallite size in the resolidified region is determined as a function of position. By comparison with Rutherford backscattering spectra and Raman spectra from nonosecond pulsed laser melting experiments, the disorder depth for picosecond pulsed laser melted graphite is determined as a function of irradiating energy density. Comparisons of TEM micrographs for nanosecond and picosecond pulsed laser melting experiments show that the structure of the laser disordered regions in graphite is similar and exhibits similar behavior with increasing laser pulse fluence. DOE

N87-21125# Allied Bendix Aerospace, Kansas City, Mo.
FABRICATION OF OPEN CELL EPOXY FOAM Final Report
J. W. Schneider Feb. 1987 24 p
(Contract DE-AC04-76DP-00613)
(DE87-006186; BDX-613-3664) Avail: NTIS HC A02/MF A01

A rigid, low density, open cell, low volatile epoxy foam was successfully developed. A temporary urea filler was leached from an epoxy system to form the 0.3 g/cu cm foam system. Compressive strengths of approximately 400 psi at 75 C were achieved. DOE

N87-21126# Centre d'Essais Aeronautique Toulouse (France).
PREIMPREGNATED T5A-145-12-F584 CARBON/EPOXY FROM HEXCEL-GENIN: ELEMENTARY CHARACTERIZATION Final Progress Report [PREIMPREGNE CARBONE/EPOXY T5A-145-12/F584 D'HEXCEL-GENIN. CARACTERISATION ELEMENTAIRE. PROCESS VERBAL M5-517700]
9 Jun. 1986 42 p In FRENCH
(PV-M5-517700; ETN-87-99389; FPR-2) Avail: NTIS HC A03/MF A01

A composite system was implemented by IM6 Hercules fibers and a modified epoxy resin designed to improve resilience. The operating parameters indicate a low reinforcement volume fraction (55%). The mechanical properties are found to be of the same order as expected for second generation composites. The delamination tests show improved strength (240 J/cu m). ESA

N87-21127# Technische Hogeschool, Eindhoven (Netherlands).
MICROSTRUCTURAL INVESTIGATION OF COPOLYMERS. A KEY IN REVEALING RELATIONS BETWEEN POLYMERIZATION CONDITIONS AND POLYMER PROPERTIES Ph.D. Thesis
Jacobus Christinus Josephus F. Tacx 1986 170 p
(ETN-87-99585) Avail: NTIS HC A08/MF A01

Semiquantitative models to predict the three dimensional molar mass chemical composition distribution (MMCCD) and quantitative models to predict diad and triad fractions of copolymers prepared by solution copolymerization till high conversion, were developed. For the evaluation of experimental MMCCD's, a crossfractionation method was elaborated. Crossfractionation, NMR data, and model calculations show that the observed MMCCD and triad fractions of solution products agree with predicted MMCCD's and triad fractions. High conversion products exhibit significantly different Tg's compared with low conversion products having approximately the same composition and molar mass due to differences in (predictable) product distributions. Products obtained by emulsion copolymerization exhibit a significantly anomalous intra and intermolecular structure. These anomalies also show up in the properties of the emulsion products. ESA

N87-21128# Office of Technology Assessment, Washington, D.C.
NEW STRUCTURAL MATERIALS TECHNOLOGIES: OPPORTUNITIES FOR THE USE OF ADVANCED CERAMICS AND COMPOSITES
Sep. 1986 88 p
(PB87-118253; OTA-TM-E-32; LC-86-600551) Avail: NTIS HC A05/MF A01 CSCL 11B

New structural materials-ceramics, polymers, metals, or hybrid materials derived from these, called composites-open a promising avenue to renewed international competitiveness of U.S. manufacturing industries. There will be many opportunities for use of the materials in aerospace, automotive, industrial, medical, and construction applications in the next 25 years. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N87-21129*# Case Western Reserve Univ., Cleveland, Ohio.
SIZE AND SHAPE OF SOLID FUEL DIFFUSION FLAMES IN VERY LOW SPEED FLOWS M.S. Thesis. Final Report
David W. Foutch Feb. 1987 122 p
(Grant NGT-36-027805)
(NASA-CR-179576; NAS 1.26:179576) Avail: NTIS HC A06/MF A01 CSCL 21D

The effect of very low speed forced flows on the size and shape of a solid fuel diffusion flame are investigated experimentally. Flows due to natural convection are eliminated by performing the experiment in low gravity. The range of velocities tested is 1.5 cm/s to 6.3 cm/s and the mole fraction of oxygen in the O2/N2 atmosphere ranges from 0.15 to 0.19. The flames did not reach steady state in the 5.2 sec to which the experiment was limited. Despite limited data, trends in the transient flame temperature and, by means of extrapolation, the steady state flame size are deduced. As the flow velocity is reduced, the flames move farther from the fuel surface, and the transient flame temperature is lowered. As the oxygen concentration is reduced the flames move closer to the fuel sample and the transient flame temperature is reduced. With stand off distances up to 8.5 + or - 0.7 mm and thicknesses around 1 or 2 mm, these flames are much weaker than flames observed at normal gravity. Based on the performance of the equipment and several qualitative observations, suggestions for future work are made. Author

N87-21130# Weapons Research Establishment, Salisbury (Australia). Weapons Systems Research Lab.
A SOLID PROPELLANT CHARGE DESIGN WITH NEGATIVE EFFECTIVE PRESSURE EXPONENT USING FORCED CONE BURNING
R. D. Irvine and P. C. Winch Oct. 1986 26 p
(WSRL-0469-TR; AR-004-859) Avail: NTIS HC A03/MF A01

A novel method of making a solid propellant rocket motor or gas generator charge with a negative effective burning rate pressure exponent (negative dr sub b/dP) is presented. The negative exponent characteristic can be obtained independently of burning rate and other bulk propellant properties (specific impulse, flame temperature, signature, mechanical properties, etc.) which can be chosen as required. The charge is constructed with a core, (or several cores), of propellant with an intrinsically negative pressure exponent with the bulk of the charge made up of any propellant with a lower burning rate than the core propellant over the pressure range of interest. The core propellant burning rate range can be adjusted to give the desired value by a method of burning rate acceleration. Suitable core materials and burning rate acceleration methods are reported, and the use of such a charge in a rocket motor or gas generator with a variable area nozzle to give controllable thrust is discussed. Author

N87-21131# Naval Postgraduate School, Monterey, Calif.
HOLOGRAPHIC INVESTIGATION OF METALLIZED SOLID PROPELLANT COMBUSTION IN A THREE-DIMENSIONAL MOTOR M.S. Thesis
James B. Rubin Sep. 1986 45 p
(AD-A176140) Avail: NTIS HC A03/MF A01 CSCL 21/8

An experimental investigation was performed to determine the feasibility of obtaining particle size data using pulsed-ruby holography in a three-dimensional metallized solid propellant rocket motor. Holograms of a USAF Resolution Target and a LEOS dot target were taken under various conditions, with the system resolution determined to be under 5 microns. Good quality holograms were obtained at pressures of 91, 110, and 280 psi using an HTPB/ammonium perchlorate propellant with 2 percent, 20 micron aluminum. Holograms were not successful at a pressure of 240 psi and 560 psi with a 2 percent aluminized AP/GAP propellant. For this propellant, transmittance tests indicated complete opacity during the steady-state portion of the burn. GRA

N87-21132# Naval Postgraduate School, Monterey, Calif.
IMPLEMENTATION OF THREE SPECKLE REDUCTION FILTERS FOR SOLID PROPELLANT COMBUSTION HOLOGRAMS M.S. Thesis
Thomas D. Edwards Dec. 1986 57 p
(AD-A176583) Avail: NTIS HC A04/MF A01 CSCL 14/5

Speckle noise appears when a diffuse light hologram of a particle field is reconstructed with a laser. The speckle must be reduced so that particles of interest may be counted and sized. This thesis describes speckle and a figure of merit known as the speckle index. Three speckle reduction filters suggested by work in the area of synthetic aperture radars were implemented, discussed and compared. An IBM AT personal computer with Itex/PC image processing software was used for the comparison. The geometric filter performed best overall, but may not be superior in every circumstance. GRA

N87-21133# California Inst. of Tech., Pasadena. Dept. of Chemistry.
TETRAHYDROGEN Final Report, 15 Aug. 1985 - 15 Oct. 1986
Aron Kuppermann Jan. 1987 29 p
(Contract F04611-85-C-0054)
(AD-A176778; AFRPL-TR-86-103) Avail: NTIS HC A03/MF A01 CSCL 07/2

Recent theoretical calculations have suggested the existence of metastable tetrahydrogen (H4) molecules (in the superscript 1 A prime state). The specific impulse of this species is estimated to be 1820s, making it a very interesting candidate for a rocket propulsion system. One possible means of producing this molecule experimentally is through chemical reaction in a crossed molecular beam as an intense beam of long lived metastable H3 molecules formed by an arc discharge through hydrogen, which provides gas phase electronic temperatures in the range of 10,000 to 15,000 C. The secondary beam of hydrogen iodide molecules is produced by expansion through a glass capillary array. The scattered products of the tri-hydrogen + hydrogen iodide collisions are measured with the help of an electron bombardment quadrupole mass spectrometer, having two angular motion degrees of freedom. This complex apparatus was put together and made operational after an extended series of improvements. Preliminary experiments were performed and the results indicated that it will indeed permit the proposed reaction to be investigated in detail. GRA

N87-21134# Federal Aviation Agency, Atlantic City, N.J.
DEVELOPMENT OF A LARGE-SCALE ANTIMISTING KEROSENE BLENDER Final Report, Sep. 1982 - Dec. 1984
H. S. Byrnes Oct. 1986 58 p
(AD-A176997; DOT/FAA/CT-86/11) Avail: NTIS HC A04/MF A01 CSCL 21/4

Development of a large-scale inline antimisting kerosene (AMK) blender was undertaken to demonstrate the feasibility of inline blending on a scale that would be representative of in-service use requirements. Inline blending was developed as means of circumventing problems that would be encountered with the use of batch-blended AMK, including: (1) unintentional degradation, (2) bulk water incompatibility, (3) filtering difficulties, and (4) shelf life. The development of the large-scale blender is traced from the laboratory-scale blender (1/2 gpm), through the continuous inline blender (10 gpm), and the intermediate blender (5 to 25 gpm). All the iterations of each unit that lead to the final configuration of the large-scale blender, which successfully performed the objective, are presented. GRA

N87-21135# IIT Research Inst., Bartlesville, Okla. National Inst. for Petroleum and Energy Research.
TECHNIQUES TO DETERMINE PARTICULATES IN LIQUID FUELS Status Report
O. K. Bhan and D. W. Brinkman Sep. 1986 23 p Prepared for DOE and Naval Air Propulsion Center, Trenton, N.J.
(Contract DE-FC22-83FE-60149)
(DE87-002028; NIPER-202) Avail: NTIS HC A02/MF A01

The objective of the current study is to search for test methods and techniques which can be used for fuel contaminant detection possibly under field conditions. In this report, several techniques have been identified which hold promise for jet fuel contaminant detection under field conditions. Instrumentation currently available for the aforementioned application are discussed and recommendations are made. Out of the ten techniques described in this review, four techniques (light scattering, ultrasonic attenuation, laser light obscuration, and laser holography) seem to hold promise for detecting particulates, and to some extent water, in jet fuels. For most of the methods, off-the-shelf instruments are available. Almost all of the equipment available requires ac 110/220 V power; however, some of the instruments can be modified for dc voltage use. In addition, some of the instruments can be miniaturized for field use. DOE

N87-21136# IIT Research Inst., Bartlesville, Okla. National Inst. for Petroleum and Energy Research.
STABILITY, COMPATIBILITY, AND RELATED PROBLEMS OF ADDITIVES IN NAVAL DISTILLATE FUELS DERIVED FROM LOWER QUALITY FEEDSTOCKS
D. W. Brinkman and K. Q. Stirling Feb. 1987 63 p Prepared in cooperation with Department of Energy, Washington, D.C., and Naval Research Lab., Washington, D.C.
(Contract DE-FC22-83FE-60149)
(DE87-001223; NIPER-222) Avail: NTIS HC A04/MF A01

A DOE/U.S. Navy study is done to determine which antioxidant additives are most effective in delaying fuel degradation in a variety of middle distillate straight run/light cycle oil blends. Straight-run middle distillate and catalytically cracked product were mixed at ratios of 85:15, 70:30, and 60:40, respectively. All these

blended fuels were treated with commercially available additives. Usual dosages were 12 and 24 ppM (volume/volume). Stability testing and fuel characterizations performed at four laboratories were used to evaluate the additives. Each used a different type stability test. The characterization studies were performed to ensure that the base fuel blends tested were within the range allowed by MIL-F-16884H and to determine whether any of the additives would make the fuels unacceptable for Navy use. Because of the high degree of stability of several of the control (additive-free) fuels, it was difficult to differentiate additive effectiveness in these fuels. Studies were done to see if controlled aging techniques prior to stability testing could increase the amount of sediment in the fuel. Results showed that this would result in some cases and have no effect in others. In cases where control fuels exhibited instability, it was possible to demonstrate the relative effectiveness of the 12 stabilizer additives. Five of the additives were shown to be superior. DOE

N87-21137# Texas Univ., Austin. Dept. of Chemistry.
VECTORIAL ELECTRON TRANSFER ON DESIGNED SURFACES Annual Report, Feb. 1985 - Jan. 1986
A. J. Bard, A. Campion, M. A. Fox, S. E. Webber, and J. M. White 1986 116 p
(Contract GRI-5082-260-0756)
(PB87-144325; GRI-86/0213) Avail: NTIS HC A06/MF A01 CSCL 07D

The oxidation of bromide to bromine on platinized TiO2 supported on Nafion and unsupported has been studied. Platinized TiO2 is not stable in oxygenated aqueous KBr solutions as K2PtBr6 if formed. Supporting the TiO2 on Nafion improves the catalytic performance. Luminescence studies of CdS and CdS.ZnS in Nafion suggest separate but intimately contacted phases. Prolonged irradiation produces a luminescent ZnS phase. The flatband potential of CdS has been measured for three different forms of CdS and by three different methods. The effect of annealing films and treatment of powders with zinc ion on the intra band gap states and the improvement in the Cds particle system for hydrogen evolution is discussed. Vectorial electron transfer has been demonstrated on dipolar TiO2/Pt semiconductor photoelectrodes and multielectrode arrays. The electrodes consist of an anodized TiO2 film with a backing of Pt serving as the cathodic surface of the bipolar electrode. With five panels in series, voltages in excess of 3.6 volts are obtained. These arrays can be used for electrical power generation or water photolysis yielding the separated products of hydrogen and oxygen. GRA

N87-21138# National Academy of Sciences - National Research Council, Washington, D. C.
ENERGETIC MATERIALS FOR MILITARY PURPOSES: AN ASSESSMENT Final Report
1986 38 p
(Contract DAAG29-82-C-0012)
(PB87-137220) Avail: NTIS HC A03/MF A01 CSCL 19A

An assessment of energetic materials and related technologies was requested by the Department of the Army. In this context, the term energetic materials means explosives, propellants, and pyrotechnics, as well as incendiary substances and fuel/air explosives and, as appropriate, the modes of applying such material in weapon systems. The second study was a technical/military operations analysis. In addition, an evaluation of whether the level of progress activities is appropriate in view of an alarming evaluation of munitions program activities in the Soviet Union. Delivery means, guidance, warheads, fuses, and weapons effects were addressed. B.G.

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology*.

N87-21139*# National Bureau of Standards, Boulder, Colo. Center for Chemical Engineering.
COMPUTER CODE FOR GAS-LIQUID TWO-PHASE VORTEX MOTIONS: GLVM
T. T. Yeh Jul. 1986 45 p Sponsored by NASA
(NASA-CR-180265; NAS 1.26:180265; PB87-140570; NBSIR-86-3414) Avail: NTIS HC A03/MF A01 CSCL 07D

A computer program aimed at the phase separation between gas and liquid at zero gravity, induced by vortex motion, is developed. It utilizes an explicit solution method for a set of equations describing rotating gas-liquid flows. The vortex motion is established by a tangential fluid injection. A Lax-Wendroff two-step (McCormack's) numerical scheme is used. The program can be used to study the fluid dynamical behavior of the rotational two-phase fluids in a cylindrical tank. It provides a quick/easy sensitivity test on various parameters and thus provides the guidance for the design and use of actual physical systems for handling two-phase fluids. GRA

N87-21140*# Alabama Univ., Huntsville.
FIBER GLASS PULLING Final Report
Gary L. Workman 1 Mar. 1987 38 p
(Contract NAS8-35978)
(NASA-CR-179036; NAS 1.26:179036; UAH-592) Avail: NTIS HC A03/MF A01 CSCL 22A

Experiments were conducted to determine the viability of performing containerless glass fiber pulling in space. The optical transmission properties and glass-forming capabilities of the heavy metal fluorides are reviewed and the acoustic characteristics required for a molten glass levitation system are examined. The design limitations of, and necessary modifications to the acoustic levitation furnace used in the experiments are discussed in detail. Acoustic levitator force measurements were performed and a thermal map of the furnace was generated from thermocouple data. It was determined that the thermal capability of the furnace was inadequate to melt a glass sample in the center. The substitution of a 10 KW carbon monoxide laser for the original furnace heating elements resulted in improved melt heating. M.G.

N87-21141*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MICROGRAVITY FLUID MANAGEMENT SYMPOSIUM
Apr. 1987 225 p Symposium held in Cleveland, Ohio, 9-10 Sep. 1986
(NASA-CP-2465; E-3386; NAS 1.55:2465) Avail: NTIS HC A10/MF A01 CSCL 22A

The NASA Microgravity Fluid Management Symposium, held at the NASA Lewis Research Center, September 9 to 10, 1986, focused on future research in the microgravity fluid management field. The symposium allowed researchers and managers to review space applications that require fluid management technology, to present the current status of technology development, and to identify the technology developments required for future missions. The 19 papers covered three major categories: (1) fluid storage, acquisition, and transfer; (2) fluid management applications, i.e., space power and thermal management systems, and environmental control and life support systems; (3) project activities and insights including two descriptions of previous flight experiments and a summary of typical activities required during development of a shuttle flight experiment. For individual titles, see N87-21142 through N87-21158.

N87-21142*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ADVANCED LONG TERM CRYOGENIC STORAGE SYSTEMS **c18**
Norman S. Brown *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 7-16 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22B

Long term, cryogenic fluid storage facilities will be required to support future space programs such as the space-based Orbital

Transfer Vehicle (OTV), Telescopes, and Laser Systems. An orbital liquid oxygen/liquid hydrogen storage system with an initial capacity of approximately 200,000 lb will be required. The storage facility tank design must have the capability of fluid acquisition in microgravity and limit cryogen boiloff due to environmental heating. Cryogenic boiloff management features, minimizing Earth-to-orbit transportation costs, will include advanced thick multilayer insulation/integrated vapor cooled shield concepts, low conductance support structures, and refrigeration/reliquefaction systems. Contracted study efforts are under way to develop storage system designs, technology plans, test article hardware designs, and develop plans for ground/flight testing. Author

N87-21143*# General Dynamics Corp., San Diego, Calif. Space Systems Div.
LONG TERM CRYOGENIC STORAGE FACILITY SYSTEMS STUDY **c18**
John R. Schuster *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 17-30 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22B

The Long Term Cryogenic Storage Facility Systems Study (LTCSFSS) is a Phase A study of a large capacity propellant depot for the space based, cryogenic orbital transfer vehicle. The study is being performed for Marshall Space Flight Center by General Dynamics Space Systems Division and has five principal objectives: (1) Definition of preliminary concept designs for four storage facility concepts; (2) Selection of preferred concepts through the application of trade studies to candidate propellant management system components; (3) Preparation of a conceptual design for an orbital storage facility; (4) Development of supporting research and technology requirements; and (5) Development of a test program to demonstrate facility performance. The initial study has been completed, and continuation activities are just getting under way to provide greater detail in key areas and accommodate changes in study guidelines and assumptions. Author

N87-21144*# Beech Aircraft Corp., Boulder, Colo.
SPACE STATION EXPERIMENT DEFINITION: LONG TERM CRYOGENIC FLUID STORAGE **c18**
David H. Riemer *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 31-42 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22B

A preliminary design of an experiment to demonstrate and evaluate long-term cryogenic fluid storage and transfer technologies has been performed. This Long-Term Cryogenic Fluid Storage (LTCFS) experiment is a Technology Development Mission (TDM) experiment proposed by the NASA Lewis Research Center to be deployed on the Initial Operational Capability (IOC) space station. Technologies required by future orbital cryogenic systems such as Orbital Transfer Vehicles (OTV's) were defined, and critical technologies requiring demonstration were chosen to be included in the experiment. A three-phase test program was defined to test the following types of technologies: (1) Passive Thermal Technologies; (2) Fluid Transfer Technologies; and (3) Active Refrigeration Technologies. The development status of advanced technologies required for the LTCFS experiment is summarized, including current, past and future programs. Author

N87-21145*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HELIUM TECHNOLOGY ISSUES
Peter Kittel *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 43-55 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

A number of future space missions require liquid helium for cooling scientific payloads. These missions will require the long term storage and resupply of liquid helium at temperatures of 1.4 - 2.1 Kelvin. In addition, some of the proposed instruments will require refrigeration to temperatures as low as 50 mK. A variety of liquid helium based refrigerator systems could provide this subkelvin cooling. The status of helium storage and refrigeration technologies and of several alternative technologies is presented here along with areas where further research and development are needed. (Helium resupply technologies are the topic of another presentation at this symposium). The technologies covered include passive and dynamic liquid helium storage, alternatives to liquid helium storage, He -3 refrigerators, He -3/He -4 dilution refrigerators, and alternative sub-kelvin coolers. Author

N87-21146*# Boeing Aerospace Co., Seattle, Wash.
OVERVIEW: FLUID ACQUISITION AND TRANSFER
Jere S. Meserole *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 57-65 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

This brief overview introduced the symposium session on microgravity fluid acquisition and transfer. It states the objective of NASA efforts in this technology and the approach being taken in the technology program. The problems are outlined and various methods for low-gravity fluid acquisition and transfer are summarized. Applications for the technology are described and an assessment of the current state of the art is presented. NASA and DOD on-going and planned programs are listed. Author

N87-21147*# Massachusetts Inst. of Tech., Cambridge.
THE COUPLED DYNAMICS OF FLUIDS AND SPACECRAFT IN LOW GRAVITY AND LOW GRAVITY FLUID MEASUREMENT
R. John Hansman, Lee D. Peterson, and Edward F. Crawley *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 67-84 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

The very large mass fraction of liquids stored on broad current and future generation spacecraft has made critical the technologies of describing the fluid-spacecraft dynamics and measuring or gauging the fluid. Combined efforts in these areas are described, and preliminary results are presented. The coupled dynamics of fluids and spacecraft in low gravity study is characterizing the parametric behavior of fluid-spacecraft systems in which interaction between the fluid and spacecraft dynamics is encountered. Particular emphasis is given to the importance of nonlinear fluid free surface phenomena to the coupled dynamics. An experimental apparatus has been developed for demonstrating a coupled fluid-spacecraft system. In these experiments, slosh force signals are fed back to a model tank actuator through a tunable analog second order integration circuit. In this manner, the tank motion is coupled to the resulting slosh force. Results are being obtained in 1-g and in low-g (on the NASA KC-135) using dynamic systems nondimensionally identical except for the Bond numbers. Author

N87-21148*# Washington Univ., St. Louis, Mo.
NUMERICAL MODELLING OF CRYOGENIC PROPELLANT BEHAVIOR IN LOW-G
John I. Hochstein *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 85-100 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

A partial survey is presented of recent research, sponsored by the NASA Lewis Research Center, into the computational modelling of cryogenic propellant behavior in a low gravity environment. This presentation is intended to provide insight into some of the specific problems being studied and into how these studies are part of an integrated plan to develop predictive capabilities. A brief description of the computational models developed to analyze jet induced mixing in cryogenic propellant tankage is presented along with representative results. Similar information is presented for a recent examination of on-orbit self-pressurization. A study of propellant reorientation has recently been initiated and preliminary results are included. The presentation concludes with a list of ongoing efforts and projected goals.
Author

N87-21149*# Boeing Aerospace Co., Kent, Wash.
MIXING-INDUCED FLUID DESTRATIFICATION AND ULLAGE CONDENSATION
Jere S. Meserole, Ogden S. Jones, and Anthony F. Fortini (Anthony Enterprises, Federal Way, Wash.) *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 101-117 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

In many applications, on-orbit storage and transfer of cryogens will require forced mixing to control tank pressure without direct venting to space. During a no-vent transfer or during operation of a thermodynamic vent system in a cryogen storage tank, pressure control is achieved by circulating cool liquid to the liquid-vapor interface to condense some of the ullage vapor. To measure the pressure and temperature response rates in mixing-induced condensation, an experiment has been developed using Freon 11 to simulate the two-phase behavior of a cryogen. A thin layer at the liquid surface is heated to raise the tank pressure, and then a jet mixer is turned on to circulate the liquid, cool the surface, and reduce the pressure. Many nozzle configurations and flow rates are used. Tank pressure and the temperature profiles in the ullage and the liquid are measured. Initial data from this ground test are shown correlated with normal-gravity and drop-tower dye-mixing data. Pressure collapse times are comparable to the dye-mixing times, whereas the times needed for complete thermal mixing are much longer than the dye-mixing times. Author

N87-21150*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CRYOGENIC FLUID MANAGEMENT FLIGHT EXPERIMENT (CFMFE)
David M. DeFelice *In its* Microgravity Fluid Management Symposium Apr. 1987 p 119-124 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

Since its foundation, NASA has excelled in the study and development of microgravity fluid management technology. With the advent of space-based vehicles and systems, the use of and the ability to efficiently manage subcritical cryogens in the space environment has become necessary to our growing space program. The NASA Lewis Research Center is responsible for the planning and execution of a program which will provide advanced in-space cryogenic fluid management technology. A number of future space missions have been identified that will require or could benefit from this technology. These technology needs have been prioritized and the Cryogenic Fluid Management Flight Experiment (CFMFE) is being designed to provide the experimental data necessary for the technological development effort. Author

N87-21151*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUPERFLUID HELIUM ON ORBIT TRANSFER (SHOOT)
Michael J. DiPirro *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 125-136 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

A number of space flight experiments and entire facilities require superfluid helium as a coolant. Among these are the Space Infrared Telescope Facility (SIRTF), the Large Deployable Reflector (LDR), the Advanced X-ray Astrophysics Facility (AXAF), the Particle Astrophysics Magnet Facility (PAMF or Astromag), and perhaps even a future Hubble Space Telescope (HST) instrument. Because these systems are required to have long operational lifetimes, a means to replenish the liquid helium, which is exhausted in the cooling process, is required. The most efficient method of replenishment is to refill the helium dewars on orbit with superfluid helium (liquid helium below 2.17 Kelvin). To develop and prove the technology required for this liquid helium refill, a program of ground and flight testing was begun. The flight demonstration is baselined as a two flight program. The first, described in this paper, will prove the concepts involved at both the component and system level. The second flight will demonstrate active astronaut involvement and semi-automated operation. The current target date for the first launch is early 1991.

N87-21152*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MICROGRAVITY FLUID MANAGEMENT IN TWO-PHASE THERMAL SYSTEMS
Richard C. Parish *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 139-149 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

Initial studies have indicated that in comparison to an all liquid single phase system, a two-phase liquid/vapor thermal control system requires significantly lower pumping power, demonstrates more isothermal control characteristics, and allows greater operational flexibility in heat load placement. As a function of JSC's Work Package responsibility for thermal management of space station equipment external to the pressurized modules, prototype development programs were initiated on the Two-Phase Thermal Bus System (TBS) and the Space Erectable Radiator System (SERS). JSC currently has several programs underway to enhance the understanding of two-phase fluid flow characteristics. The objective of one of these programs (sponsored by the Microgravity Science and Applications Division at NASA-Headquarters) is to design, fabricate, and fly a two-phase flow regime mapping experiment in the Shuttle vehicle mid-deck. Another program, sponsored by OAST, involves the testing of a two-phase thermal transport loop aboard the KC-135 reduced gravity aircraft to identify system implications of pressure drop variation as a function of the flow quality and flow regime present in a representative thermal system. Author

N87-21153*# Sverdrup Technology, Inc., Middleburg Heights, Ohio.
MICROGRAVITY FLUID MANAGEMENT REQUIREMENTS OF ADVANCED SOLAR DYNAMIC POWER SYSTEMS
Robert P. Migra *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 151-162 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

The advanced solar dynamic system (ASDS) program is aimed at developing the technology for highly efficient, lightweight space power systems. The approach is to evaluate Stirling, Brayton and liquid metal Rankine power conversion systems (PCS) over the temperature range of 1025 to 1400K, identify the critical technologies and develop these technologies. Microgravity fluid management technology is required in several areas of this program, namely, thermal energy storage (TES), heat pipe applications and liquid metal, two phase flow Rankine systems. Utilization of the heat of fusion of phase change materials offers potential for smaller, lighter TES systems. The candidate TES materials exhibit large volume change with the phase change. The heat pipe is an energy dense heat transfer device. A high temperature application may transfer heat from the solar receiver to the PCS working fluid and/or TES. A low temperature application may transfer waste heat from the PCS to the radiator. The liquid metal Rankine PCS requires management of the boiling/condensing process typical of two phase flow systems. Author

N87-21154*# Battelle Pacific Northwest Labs., Richland, Wash.
TWO-PHASE REDUCED GRAVITY EXPERIMENTS FOR A SPACE REACTOR DESIGN
Zenen I. Antoniak *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 163-169 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

Future space missions researchers envision using large nuclear reactors with either a single or a two-phase alkali-metal working fluid. The design and analysis of such reactors require state-of-the-art computer codes that can properly treat alkali-metal flow and heat transfer in a reduced-gravity environment. New flow regime maps, models, and correlations are required if the codes are to be successfully applied to reduced-gravity flow and heat transfer.

General plans are put forth for the reduced-gravity experiments which will have to be performed, at NASA facilities, with benign fluids. Data from the reduced-gravity experiments with innocuous fluids are to be combined with normal gravity data from two-phase alkali-metal experiments. Because these reduced-gravity experiments will be very basic, and will employ small test loops of simple geometry, a large measure of commonality exists between them and experiments planned by other organizations. It is recommended that a committee be formed to coordinate all ongoing and planned reduced gravity flow experiments. Author

N87-21155*# Hamilton Standard, Windsor Locks, Conn.
MAINTENANCE EVALUATION FOR SPACE STATION LIQUID SYSTEMS
Charles Flugel *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 171-187 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

Many of the thermal and environmental control life support subsystems as well as other subsystems of the space station utilize various liquids and contain components which are either expendables or are life-limited in some way. Since the space station has a 20-year minimum orbital lifetime requirement, there will also be random failures occurring within the various liquid-containing subsystems. These factors as well as the planned space station build-up sequence require that maintenance concepts be developed prior to the design phase. This applies to the equipment which needs maintenance as well as the equipment which may be required at a maintenance work station within the space station. This paper presents several maintenance concepts for liquid-containing items and a flight experiment program which would allow for evaluation and improvement of these concepts so they can be incorporated in the space station designs at the outset of its design phase. Author

N87-21156*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE EXPERIMENT DEVELOPMENT PROCESS
James F. DePauw *In its* Microgravity Fluid Management Symposium Apr. 1987 p 189-200 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

Described is a process for developing space experiments utilizing the Space Shuttle. The role of the Principal Investigator is described as well as the Principal Investigator's relation with the project development team. Described also is the sequence of events from an early definition phase through the steps of hardware development. The major interactions between the hardware development program and the Shuttle integration and safety activities are also shown. The presentation is directed to people with limited Shuttle experiment experience. The objective is to summarize the development process, discuss the roles of major participants, and list some lessons learned. Two points should be made at the outset. First, no two projects are the same so the process varies from case to case. Second, the emphasis here is on Code EN/Microgravity Science and Applications Division (MSAD). Author

N87-21157*# McDonnell-Douglas Corp., St. Louis, Mo.
SHUTTLE GET-AWAY SPECIAL EXPERIMENTS
George Orton *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 201-216 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

This presentation describes two shuttle Get-Away-Special (GAS) experiments built by McDonnell Douglas to investigate low-g propellant acquisition and gaging. The first experiment was flown on shuttle mission 41-G in October 1984. The second experiment has been qualified for flight and is waiting for a flight assignment. The tests performed to qualify these experiments for flight are described, and the lessons learned which can be applied to future GAS experiments are discussed. Finally, survey results from 134 GAS experiments flown to date are presented. On the basis of these results it is recommended that future GAS experiments be qualified to shuttle thermal and dynamic environments through a rigorous series of mission operating tests. Furthermore, should automatic activation of the experiment be required during the boost phase of the mission, NASA-supplied redundant barometric switches should be employed to trigger the activation. Author

N87-21158*# Martin Marietta Corp., Denver, Colo.
SHUTTLE MIDDECK FLUID TRANSFER EXPERIMENT: LESSONS LEARNED
James Tegart *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987 p 217-224 (For primary document see N87-21141 14-29)
Avail: NTIS HC A10/MF A01 CSCL 22A

This presentation is based on the experience gained from having integrated and flown a shuttle middeck experiment. The experiment, which demonstrated filling, expulsion, and fluid behavior of a liquid storage system under low-gravity conditions, is briefly described. The advantages and disadvantages of middeck payloads compared to other shuttle payload provisions are discussed. A general approach to the integration process is described. The requirements for the shuttle interfaces--such as structures, pressurized systems, materials, instrumentation, and electrical power--are defined and the approach that was used to satisfy these requirements is presented. Currently the middeck experiment is being used as a test bed for the development of various space fluid system components. Author

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N87-21159* National Aeronautics and Space Administration. Pasadena Office, Calif.
TEN DEGREE KELVIN HYDRIDE REFRIGERATOR Patent
Jack A. Jones, inventor (to NASA) Issued 10 Feb. 1987 6 p Filed 14 Feb. 1985 Supersedes N85-29084 (23 - 18, p 3085)
(NASA-Case-NPO-16393-1-CU; US-Patent-4,641,499;
US-Patent-Appl-SN-701486; US-Patent-Class-62-48;
US-Patent-Class-62-384; US-Patent-Class-62-514-R) Avail: US Patent and Trademark Office CSCL 13B

A compact hydride absorption refrigeration system with few moving parts for 10 Kelvin operation is disclosed and comprises liquid hydrogen producing means in combination with means for solidifying and subliming the liquid hydrogen produced. The liquid hydrogen is sublimed at about 10 Kelvin. By using a symmetrical all hydrogen redundant loop system, a 10 Kelvin refrigeration system can be operated for many years with only a fraction of the power required for prior art systems.
Official Gazette of the U.S. Patent and Trademark Office

N87-21160* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ION BEAM SPUTTER ETCHING Patent
Bruce A. Banks and Sharon K. Rutledge Issued 4 Nov. 1986 10 p Filed 13 Sep. 1985 Supersedes N86-20587 (24 - 11, p 1752)
(NASA-Case-LEW-13899-1; US-Patent-4,620,898;
US-Patent-Appl-SN-775968; US-Patent-Class-156-643;
US-Patent-Class-156-646; US-Patent-Class-156-659.1;
US-Patent-Class-156-661.1; US-Patent-Class-156-904;
US-Patent-Class-156-345; US-Patent-Class-204-298) Avail: US Patent and Trademark Office CSCL 13H

An ion beam etching process which forms extremely high aspect ratio surface microstructures using thin sputter masks is utilized in the fabrication of integrated circuits. A carbon rich sputter mask together with unmasked portions of a substrate is bombarded with inert gas ions while simultaneous carbon deposition occurs. The arrival of the carbon deposit is adjusted to enable the sputter

mask to have a near zero or even slightly positive increase in thickness with time while the unmasked portions have a high net sputter etch rate.

Official Gazette of the U.S. Patent and Trademark Office

N87-21161# Royal Signals and Radar Establishment, Malvern (England).
FIELD ASSISTED ETCHING
J. A. Edwards and J. D. Benjamin Nov. 1986 44 p Original contains color illustrations
(RSRE-MEMO-3715; BR101466; ETN-87-99793) Avail: NTIS HC A03/MF A01

The effects of high gravitational and electric fields on wet etching were investigated with the objective of inducing anisotropy in otherwise isotropic etch systems and of removing particulates. Although anisotropy is achieved when etching silicon in HNA and gallium arsenide in a phosphoric/sulfuric/peroxide etch in a high gravitational field, the results depend on the size and depth of the features, so are not useful in standard semiconductor processing. The use of a large gravitational field results in the removal of a substantial fraction of the particulates formed when etching aluminum/silicon/copper, and this may be technologically useful. Large gravitational fields are effective for the identification of diffusion limited etch systems. The application of a high electric field to a prototype nonconducting etch system modifies the etching and this effect merits further investigation. ESA

N87-21162# Royal Signals and Radar Establishment, Malvern (England).
METHODS FOR THINNING SILICON CHIPS
A. S. R. Martin and J. D. Benjamin Jul. 1986 24 p Original contains color illustrations
(RSRE-MEMO-3952; BR101095; ETN-87-99796) Avail: NTIS HC A02/MF A01

Results of three techniques for thinning silicon chips are described. It is found that 3 in. dia silicon wafers can be reliably thinned to thicknesses less than 20 microns by a nonselective etch. This technique is also suitable for chemically polishing silicon wafers. Selective anodization appears to be capable of thinning chips incorporating an epitaxial layer to 5 microns or less, but this is more complicated since electrical contact must be made with the sample. A selective HNA etch supposed to selectively dissolve heavily doped silicon shows inconsistent results. Methods for handling thin silicon layers and a technique for encapsulating silicon samples for electrochemical measurements and etching are also described. ESA

N87-21163# Hughes Research Labs., Malibu, Calif.
CLUSTER BEAM STUDIES Annual Report, 1 Aug. 1985 - 1 Aug. 1986
W. Knauer and R. L. Poeschel Oct. 1986 43 p
(Contract F49620-85-C-0125)
(AD-A176803; AFOSR-87-0157TR) Avail: NTIS HC A03/MF A01 CSCL 20/7

Cluster beams offer a means of depositing high quality thin films at low substrate temperature for microelectronics fabrication. The advantage of cluster beam depositions is the ability to optimize the energy of the impacting particles, either directly in clustered vapors of nonvolatile materials or indirectly by bombarding the film during deposition with clusters of insert gases. When a cluster beam is ionized and accelerated through several thousand volts, cluster that contain 1000 or more atoms strike the surface with several electron volt energy per atom. The suprathermal energy of the depositing atoms is thought to produce unique thin films (either in quality, or in the ability to be desposited at all). This report describes the general effort on cluster beam formation methods, on cluster ionization by electron bombardment in a gridded ionization cell, on electrostatic mass-separation, and on electrostatic acceleration to a predetermined velocity. Detailed results are given on the improvements in performance of ionization cells for cluster beams of nonvolatile and gaseous materials. GRA

N87-21164# Mound Lab., Miamisburg, Ohio.
DEVELOPMENT OF THE DIFFUSION BONDING PROCESS
J. J. Kwiatkowski and W. H. Jones 25 Feb. 1987 32 p
(Contract DE-AC04-76DP-00053)
(DE87-006598; MLM-3418) Avail: NTIS HC A03

The diffusion bonding process was adapted for a unique low-temperature application involving the attachment of thin copper materials used in the flexible printed circuit industry. The work completed to date has demonstrated the feasibility of welding 0.0002-in. thick copper foil to 0.0014-in. thick oxygen-free, high-conductivity (OFHC) copper sheeting. The 0.0002-in. foil is an electrodeposited material on a Kapton substrate. The 0.0014-in. copper sheet is part of a cable assembly consisting of Kapton, epoxy, Pyralux adhesive, and additional copper layers. Heat must be applied through all these materials to effect welding at the interface. Diffusion bonding parameters of 5000 psi, a 3-min time period, and a weld interface temperature of 288 C (550 F) were found to form effective welds without causing appreciable degradation of the assembly, as shown by high voltage breakdown testing. DOE

N87-21165# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[ACTIVITIES REPORT IN ENERGY SCIENCE] Annual Report, 1985
Oct. 1986 24 p Original contains color illustrations
(ETN-87-99373) Avail: NTIS HC A02/MF A01

Numerical simulation of the three-dimensional unsteady flow of an inviscid fluid through a turbomachine stage; numerical simulation of the unsteady operation of a compressor in the presence of inlet distortion; the cooling of turbomachine cascades and disks; numerical simulation of three-dimensional reactive flows in a primary zone of a simplified combustor; a method for calculating standard formation enthalpies for molecules to be used in high specific impulse propellants; measurement of solid propellant burning rates; development of semipropellants for air-breathing propulsion; and supersonic ramjet development are described. ESA

N87-21166# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[ACTIVITIES REPORT IN STRUCTURES] Annual Report, 1985
Oct. 1986 26 p Original contains color illustrations
(ETN-87-99375) Avail: NTIS HC A03/MF A01

A stiffened plate macro-element; a macro-element of elastic pipe filled with liquid; modeling of the structural fuzzy in medium frequency computations; unsteady aerodynamic forces on jet engine air intakes; prediction of buffeting vibrations from unsteady pressure measurements taken in a wind tunnel; aeroelastic behavior of fan blades in the unstarted supersonic domain; wind tunnel study of a helicopter blade stall control; computer-controlled generator of turbulence in a wind tunnel; atmospheric turbulence statistics; adaptation of Neuber's theory to viscoplastic stress concentration; computation of a jet engine disk/flange assembly; and analysis of the damage done to a perforated composite plate under biaxial monotonic and cyclic loading are described. ESA

N87-21167# Bjorksten Research Labs., Inc., Madison, Wis.
ICE-MELTING CHARACTERISTICS OF CALCIUM MAGNESIUM ACETATE Executive Summary
R. U. Schenk Jan. 1986 15 p
(Contract DTFH61-83-C-00041)
(PB87-122123; FHWA/RD-86/180) Avail: NTIS HC A02/MF A01 CSCL 13B

The objectives of the study are to determine the pertinent properties of Calcium/Magnesium Acetate and to determine the pH and ratio of calcium to magnesium that provide optimum road deicing characteristics. GRA

N87-21168# Environmental Protection Agency, Cincinnati, Ohio.
APPROACH TO EVALUATING LEAK DETECTION METHODS IN UNDERGROUND STORAGE TANKS
J. Starr, J. Broscious, and S. Niaki Oct. 1986 24 p Prepared in

cooperation with Enviresponse, Inc., Livingston, N.J. and IT Corp., Pittsburgh, Pa.
(PB87-118444; EPA-600/D-86-242) Avail: NTIS HC A02/MF A01 CSCL 13B

The detection and evaluation of leaks in underground storage tanks require a detailed knowledge of conditions both within the tank and in the nearby surroundings. The test apparatus, as constructed, enables data regarding these environmental conditions to be readily obtained and incorporated in a carefully structured test program that minimizes the amount of costly full-scale testing that would otherwise be required to evaluate volumetric leak detection methods for underground storage tanks. In addition, sufficient flexibility has been designed into the apparatus to enable additional evaluations of non-volumetric test methods to be conducted, and different types of tanks and products to be tested in a cost-effective manner. GRA

N87-21169# National Bureau of Standards, Gaithersburg, Md. Center for Fire Research.
COMPARISON OF THE TOXICITY OF THE COMBUSTION PRODUCTS FROM A FLEXIBLE POLYURETHANE FOAM AND A POLYESTER FABRIC EVALUATED SEPARATELY AND TOGETHER BY THE NBS (NATIONAL BUREAU OF STANDARDS) TOXICITY TEST METHOD AND A CONE RADIANT HEATER TOXICITY TEST APPARATUS
B. C. Levin, E. Braun, J. L. Gurman, and M. Paabo Nov. 1986 71 p Sponsored by Consumer Product Safety Commission
(PB87-140265; NBSIR-86-3457) Avail: NTIS HC A04/MF A01 CSCL 13B

Representative specimens of flexible polyurethane foam and polyester fabric were thermally decomposed separately and together in order to compare the toxicity of the combustion products from the combined materials with those from the single homogeneous materials and to compare the toxicological results obtained with the NBS Toxicity Test Method with those using a cone radiant heater toxicity test apparatus. Gas concentrations (CO, CO2, O2 and HCN), blood carboxyhemoglobin, and LC(sub 50) values in Fischer 344 rats were determined for the materials under both flaming and non-flaming conditions. With the NBS Toxicity Test Method, the results of the non-flaming combined experiments indicated that both materials contributed in an additive manner to the concentration of the combustion products. However, under flaming conditions, the generation of HCN is greater than that predicted from the addition of the maximum amounts produced by the materials separately. GRA

N87-21170# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.
ADVANCED INSTRUMENTATION FOR AERO ENGINE COMPONENTS [IN ENGLISH AND FRENCH]
Loughton, England Nov. 1986 556 p Symposium held in Philadelphia, Pa., 19-23 May 1986
(AGARD-CP-399; ISBN-92-835-0401-1) Avail: NTIS HC A24/MF A01

The Symposium was addressed to research scientists and development engineers for aero engines in order to discuss the state-of-the-art and to be informed on new measurement possibilities. The scope included Coherent Anti-Stokes Raman Spectroscopy (CARS), laser anemometry, pyrometry, clearance measurement including X-ray, high speed data acquisition and processing, stress measurement and vibration and thin layer technique, unsteady and transient phenomena, and future prospects. For individual titles, see N87-21171 through N87-21205.

N87-21171# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Physikalische Chemie der Verbrennung.
SIMULTANEOUS TEMPERATURE MEASUREMENTS WITH RAMAN AND CARS IN LAMINAR FLAMES c25
W. Stricker, W. Kreutner, and Th. Just *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Spatially resolved temperature measurements in laminar premixed flames were made using Coherent Anti-Stokes Raman Scattering (CARS) and spontaneous Raman spectroscopy. In the case of narrowband (scanning) CARS, the experimental arrangement allows the performance of simultaneous temperature measurements with both techniques. For broadband (multiplex) CARS the measurements have to be made successively. Three different Raman linewidth models were used for CARS data evaluation. The results were compared with the independently recorded rotational Raman temperatures. Temperature differences up to 10% were observed, depending on the linewidth model used. For two, more complicated linewidth models the CARS and Raman temperatures are in good agreement. Author

N87-21172# United Kingdom Atomic Energy Authority, Harwell (England). Combustion Centre.
CARS THERMOMETRY FOR LOW AND HIGH PRESSURE COMBUSTION SYSTEMS c25
Douglas A. Greenhalgh *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 26 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The theory and application of broadband Coherent Anti-Styles Raman Spectroscopy (CARS) for ambient (low) and high pressure combustion thermometry is discussed. The accuracy of broadband CARS is assessed from 300 to 3500 Kelvin for pressures around 1 bar, and from 300 to 700 Kelvin for pressures from 1 to 20 bar. The use of CARS thermometry for both average and instantaneous measurements is discussed. Systematic accuracy strongly depends on the quality of the spectral model used in the CARS data analysis step. CARS spectral modelling methods are discussed with particular reference to important recent developments. Instantaneous CARS accuracy is importantly influenced by noise arising in both the broadband dye laser and the multichannel detector. Both of these factors, and their relative influences are assessed. The application of CARS thermometry is illustrated by application to both in-cylinder studies of an operating production i.c. petrol engine and to turbulent combustion in an oil-fired 30 kilowatt furnace. Author

N87-21173# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
ACCURATE MEASUREMENTS OF COMBUSTION SPECIES CONCENTRATIONS USING CARS c25
R. L. Farrow *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 16 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Results are given of research at the Combustion Research Facility, Sandia National Laboratories, on improving the capabilities of Coherent Anti-Stokes Raman Spectroscopy (CARS) for species concentration measurements in combustion gases. Scanning CARS experiments based on single- and multi-mode Nd:YAG lasers, and on pulse-amplified and conventional pulsed dye lasers have been used to evaluate an in situ normalization technique, to measure Raman linewidths in flames, and to determine nonresonant electronic susceptibilities. Experimental and theoretical considerations affecting concentration measurement accuracy are discussed. Author

N87-21174# Defence Research Establishment, Ottawa. (Ontario).
NONLINEARITY AND SINGLE SHOT NOISE PROBLEMS IN CARS SPECTROSCOPY c25
D. R. Snelling, G. J. Smallwood, R. A. Sawchuk, and T. Parameswaran *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 19 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The design and operation of a Coherent Anti-Stokes Raman Spectroscopy (CARS) spectrometer and its use to perform accurate temperature measurements in a simple laboratory flat-flame burner are discussed. Instrumental sources of systematic

error and noise in CARS temperature measurements are discussed. An analysis of the system noise is presented and the use of the measured noise to perform weighted least mean squares fits of experimental and theoretical CARS spectra is discussed. The use of a weighted fit is shown to markedly improve the precision of single pulse CARS temperature measurements. Finally, the incorporation of some recent advances in CARS theory which have resulted in more computationally efficient algorithms for calculating theoretical CARS spectra and their effect on the accuracy of temperature measurements are discussed. Author

N87-21175# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

APPLICATION OF CARS THERMOMETRY TO A TURBULENT FLAME [APPLICATION DE LA METHODE DRASC A LA MESURE DE LA TEMPERATURE DANS UNE FLAMME TURBULENTE] c25

Philippe Magre, Pierre Moreau, Gerard Collin, and Michel Pealat *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 19 p In FRENCH; ENGLISH summary (For primary document see N87-21170 14-31)

Avail: NTIS HC A24/MF A01

The good spatial and temporal resolution of broad-band Coherent Anti-Stokes Raman Spectroscopy (CARS) diagnostic is suitable for turbulent flows and allows instantaneous temperature measurements in the reaction zone. From these instantaneous values, temperature probability density functions (PDF) are built. CARS thermometry is applied to a high velocity premixed flame. The combustion of an air-methane flow (u approx. equal to 55 m/s, T approx. equal to 560 K, equivalence ratio = 0,8) in the combustor is ignited and stabilized by a parallel flow of hot gases (u approx. equal to 110 m/s, T approx. equal to 2000 K). The mixing of the two flows without combustion (equivalence ratio = 0) is also studied as well as combustion stabilized by a step replacing the hot gases. Author

N87-21176*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LASER FRINGE ANEMOMETRY FOR AERO ENGINE COMPONENTS

Anthony J. Strazisar *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 32 p Sponsored by NASA (For primary document see N87-21170 14-31)

Avail: NTIS HC A24/MF A01

Advances in flow measurement techniques in turbomachinery continue to be paced by the need to obtain detailed data for use in validating numerical predictions of the flowfield and for use in the development of empirical models for those flow features which cannot be readily modelled numerically. The use of laser anemometry in turbomachinery research has grown over the last 14 years in response to these needs. Based on past applications and current developments, the key issues which are involved when considering the application of laser anemometry to the measurement of turbomachinery flowfields are discussed. Aspects of laser fringe anemometer optical design which are applicable to turbomachinery research are briefly reviewed. Application problems which are common to both laser fringe anemometry (LFA) and laser transit anemometry (LTA) such as seed particle injection, optical access to the flowfield, and measurement of rotor rotational position are covered. The efficiency of various data acquisition schemes is analyzed and issues related to data integrity and error estimation are addressed. Real-time data analysis techniques aimed at capturing flow physics in real time are discussed. Finally, data reduction and analysis techniques are discussed and illustrated using examples taken from several LFA turbomachinery applications. Author

N87-21177# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.

LASER-2 FOCUS VELOCIMETRY c36

R. Schodl *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 31 p (For primary document see N87-21170 14-31)

Avail: NTIS HC A24/MF A01

A review is given of various publications about L2F-velocimetry. Main emphasis is placed upon the important new advances of this technique. The manner of statistical data analysis of turbulent flows including the simplified version which enables a time-saving measuring procedure is described in some detail. The influence of beam diameter - beam separation ratio on the measuring accuracy and on the measuring time is treated. The capability of the L2F-system at close-to-wall measurements could be further improved. Results of measurements in a very small flow channel and in a small turbocharger compressor rotor are presented. The 3-D version of the L2F-system was successfully operated recently. The principle, the optical set-up and the signal processing are described and some first results are presented. A comparison between Laser Doppler (LD) - and Laser 2 Focus (L2F) velocimeters gives answers about such signal properties as amplitude and rate, the smallest detectable particles and about the measuring time needed, based on the probe volume dimensions. Author

N87-21178# Cranfield Inst. of Tech., Bedford (England). School of Mechanical Engineering.

SEEDING GAS FLOWS FOR LASER ANEMOMETRY c36

A. Melling *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p (For primary document see N87-21170 14-31)

Avail: NTIS HC A24/MF A01

The seeding of gas flows for laser anemometry is reviewed. The specification and determination of the size of seeding particles to ensure both an adequate response to velocity changes of the flowing medium and a sufficient light scattering capability are examined critically. A compromise between these conflicting criteria is generally given as an upper limit on acceptable particle size, expressed as the diameter of an equivalent spherical particle. Problems arise in defining and quantifying this equivalent diameter, generating particles of suitable size from a given material, measuring the particle size distribution at the generator exit, and determining the size distribution actually seen by the laser anemometer. Recommendations are made for particle generators, sizing methods, and interpreting the significance of quoted particle distributions for laser anemometry purposes. Author

N87-21179# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

HOW TO SELECT A LASER VELOCIMETER FOR A GIVEN APPLICATION? [COMMENT CHOISIR UN VELOCIMETER LASER POUR UNE APPLICATION DONNEE]

A. Boutier *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 18 p In FRENCH (For primary document see N87-21170 14-31)

Avail: NTIS HC A24/MF A01

The different types of laser velocimeters are described with reference to their domains of utilization, their qualities, and their limitations. The fringe velocimeters are suited for acquiring local and instantaneous velocity vectors, mean velocity vectors and complete Reynolds Tensors. Their most serious limitation is their inability to measure velocities near the wall which the beams normally strike. This is why two-point velocimeters have been developed for applications with turbomachines where fluid flows are confined to very narrow channels. On the other hand these two-point velocimeters cannot probe flows with a turbulence rate exceeding 10 to 15%. A model of a two-beam velocimeter at ONERA has given very promising results with highly turbulent flows. A conspectus is presented with the objective of providing guidance in the selection of the most appropriate laser velocimeter for a given experimental condition. Author

N87-21180# Cranfield Inst. of Tech., Bedford (England). School of Mechanical Engineering.

APPLICATION OF DOPPLER AND TRANSIT LASER ANEMOMETRY IN SMALL TURBOMACHINES c36

R. L. Elder, C. P. Forster, and M. E. Gill *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 15 p

(For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The selection laser anemometry systems and their application to the particularly hostile environment found in small high speed rotating turbomachines are discussed. There are several different laser anemometry systems which are used in turbomachinery studies and when selecting a system to carry out specific duties it is necessary to have some prior knowledge of the flows to be measured, the spacial resolution required and any limitations on optical access. The optical access will often determine the spatial resolution possible and the quality of the scattered signal will generally determine the type of signal processor which can be used. The criteria used for the selection of systems at Cranfield are discussed. The arrangements in use include both the Doppler and transit systems each of which are found to have unique and very distinct advantages. Author

N87-21181# Pratt and Whitney Aircraft, East Hartford, Conn.
LASER VELOCIMETRY STUDY OF STATOR/ROTOR INTERACTIONS IN A MULTI-STAGE GAS TURBINE COMPRESSOR c36
M. Carlson Williams *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 10 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The measurement of airflow through multi-stage compressor rigs has generally been limited to the use of flow perturbing pressure and temperature probes. Although limited studies of the dynamics of these flows have been obtained with hot wire and hot film probes, the advent of the laser Doppler velocimeter (LDV) with its non-perturbing nature is expected to develop into the preferred instrumental method. To assess the feasibility of utilizing an LDV in these flows an exploratory program was recently undertaken at Pratt and Whitney. A multi-stage compressor rig, the Energy Efficient Engine high pressure compressor consisting of 6th through 15th compressor stages, was outfitted with windows between the 6th stator-7th rotor, 9th stator-10th rotor, and 13th stator-14th rotor. The windows, extending circumferentially one stator gap wide, permitted the hub to tip traversing midway between the stator trailing edge and the rotor leading edge both in and out of the stator wakes. A confocal two color, two component back scatter LDV system developed for use in gas turbine environs was employed to obtain detailed mappings to velocity magnitude and air angle as a function of rotor position at several spanwise and gapwise positions downstream of the 6th and 9th compressor stators. Although a complete mapping was not obtained, sufficient data was acquired behind the 13th stator to identify the flow's character there as well. The equipment employed in this study and the difficulties encountered are described. Author

N87-21182# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.
EVALUATION OF L2F-MEASUREMENTS IN UNSTEADY TURBINE FLOW c34
W. Foerster, R. Schodl, and H. Kruse *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 12 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The L2F-velocimeter is a suitable device with which to perform experimental studies on instationary effects in turbomachines. The execution and the evaluation of L2F-measurements within and near the rotor blade channel of a single-stage, cold air test turbine are discussed. The measurements provide information on instantaneous distribution of the 2-D flow vector as well as the components of random fluctuating velocity. The turbine rotor flow is periodically unsteady because of the upstream inlet guide vanes. In order to ensure the almost complete reconstruction of all possible rotor-to-stator orientations, the discrete measurements are evaluated by combining a local and chronological interpolation procedure. A discussion of experimental uncertainties in this application of the L2F-technique is included. Author

N87-21183*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMBINED FRINGE AND FABRY-PEROT LASER ANEMOMETER FOR 3 COMPONENT VELOCITY MEASUREMENTS IN TURBINE STATOR CASCADE FACILITY
Richard G. Seasholtz and Louis J. Goldman *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 15 p Previously announced as N86-24967 Sponsored by NASA (For primary document see N87-21170 14-31).
Avail: NTIS HC A24/MF A01 CSCL 14B

A laser anemometer is described that was developed for use in a 508 mm diameter annular turbine stator cascade facility. All three velocity components are measured through a single restricted optical port, both within the stator vane row and downstream of the vanes. The measurements are made through a cylindrical window in the casing that matches the tip radius of the cascade. The stator tested has a contoured hub endwall that results in a large radial flow near the hub. The anemometer uses a standard fringe configuration (LFA) with a fluorescent aerosol seed to measure the axial and circumferential velocity components. The radial component is measured with a confocal Fabry-Perot interferometer. The two configurations are combined in a single optical system and can operate simultaneously. Data are presented to illustrate the capabilities of the system. Author

N87-21184# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering
VELOCITY AND TEMPERATURE MEASUREMENTS IN A CAN-TYPE GAS-TURBINE COMBUSTOR c07
A. F. Bicen, M. V. Heitor (Instituto Superior Tecnico, Lisbon, Portugal), and J. H. Whitelaw *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 12 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Velocity and temperature measurements have been obtained in a can-type combustor operating at near atmospheric pressure. Velocity characteristics were determined with a laser Doppler velocimeter and a digitally compensated fine bare-wire thermocouple was used to measure the mean and rms values of temperature fluctuations. The experimental methods are emphasized. The main sources of imprecision are identified, the estimate of the related errors are evaluated. Sample results are given so as to demonstrate the effect of air-fuel ratio on the velocity and temperature characteristics of the combustor. The imprecision in velocity measurements was mainly associated with statistical errors and velocity gradient broadening effects due to the finite size of the measurement volume. The maximum statistical errors were of the order of 2 and 3% for the mean and rms values and the broadening effects can lead to overestimation by up to 25% in the rms values of the swirl velocity component near the swirl center. The error in the mean temperature was mainly due to radiation losses which monotonically increased with temperature and were less than 8%. The catalytic effects were small and limited to regions close to the fuel injector, causing a maximum increase in the mean temperature by no more than 70 K. The uncertainties in the time constant resulted in a maximum error in the rms values of the order of 7%. The effect of AFR on the velocity and temperature characteristics was relatively weak in the primary zone of the combustor. Author

N87-21185# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
THE FLOW AROUND A SQUARED OBSTACLE c34
D. F. G. Durao, M. V. Heitor, and J. C. F. Pereira *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 13 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Laser-Doppler measurements of the velocity distribution around and in the wake of a two-dimensional squared obstacle for Re=14000 are reported. The results were measured with a counter interfaced with a microprocessor. The counter was built based on a specific design to quantify and diminish errors resulting from bias sources. In addition the periodic character of the flow

in the wake was characterized by measurements of turbulence spectra with Fast Fourier Transformation instrumentation. The values of the predominant frequencies were correlated with the flow Reynolds number. Author

N87-21186# Sandia National Labs., Albuquerque, N. Mex.
SAPPHIRE FIBER OPTIC TEMPERATURE PROBE c74
D. A. Tichenor, K. R. Hencken, and R. W. Bickes, Jr. *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 5 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

A sapphire fiber optic pyrometer was developed for use in combustion environments. Two configurations of the device are described. One is designed to measure rapid gas temperature fluctuations and the other is designed to measure the rapid temperature rise in a confined pyrotechnic prior to ignition. The key element in the device is a high temperature optical fiber made of single-crystal alumina (sapphire) with a thin film of platinum deposited on one end. Temperature is derived from the intensity of thermal radiation emitted by the platinum and collected by the fiber. The device is capable of measuring rapid gas temperature fluctuations, in excess of 10kHz, in harsh environments where thermocouple life is severely limited by oxidation, corrosion, or erosion. A second configuration of the device collects infrared radiation directly from a solid object and operates in the mid-infrared to detect lower temperatures. The temperature of a confined pyrotechnic has been measured in the range from 370 to 1100 K at heating rates greater than 100 K per microsecond. Author

N87-21187# Land Turbine Sensors, Inc., Tullytown, Pa.
SOME CONSIDERATIONS RELATING TO AERO ENGINE PYROMETRY c35
P. J. Kirby *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 14 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

With turbine blade optical pyrometry rapidly becoming accepted by the aerospace community as a viable flight control technique, some of the traditional and emerging demands are described, with examples of how they are being addressed. Many of these demands are now being met by skillful application of materials technology, electronic engineering, signal processing and fluid flow techniques, but it is probable that flight conditions will impose a more pragmatic approach than customarily adopted towards test bed installations. Author

N87-21188# Technische Hochschule, Aachen (West Germany). Inst. for Jet Propulsion and Turbomachinery.
TURBINE ROTOR BLADE MEASUREMENTS USING INFRARED PYROMETRY c35
W. Koschel, D. Salden, and T. Hoch *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 16 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

An infrared pyrometer system was developed for the noncontacting measurement of metal temperatures on turbine rotor blades. The system with a high bandwidth ratio, a small target size and a high signal-to-noise ratio meets the requirements for the accuracy of temperature measurements to be performed on small gas turbines running at high speeds. The system set-up is described and special features of the probe head design, the lay-out of the detector/amplifier unit and the signal processing are discussed in detail. Results of the automated calibration of an infrared pyrometer system concerning the influence of variations in the target-to-lens distance, in the lens stop diameter and in the observation angle on the detector signal output are reported. Finally some results of temperature measurements obtained for the cooled rotor blades of a small research turbine are presented. Author

N87-21189# Naval Air Propulsion Test Center, Trenton, N.J.
HIGH RESPONSE DATA ACQUISITION SYSTEM c82
Mark K. Fall and Henry P. Dress *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

High response instrumentation is used frequently in gas turbine engine testing to determine the transient and dynamic behavior of various engine and component parameters. The Naval Air Propulsion Center (NAPC) enhanced its data acquisition and analysis capability in April 1983 with a new digital high response data acquisition system which eliminated many of the problems inherent with older analog data acquisition and analytical methods. This system has the capability of acquiring multiple parameters simultaneously at an aggregate sampling rate of up to 48,000 samples per second with on-line digitization and real time recording on a private data disk. The NAPC offline data analysis system provides same-day access to the data with the capability to display the data in various tabular and graphical formats. Analytical techniques available include time zero analysis, high pass, low pass, and band pass digital filtering, and power spectral density analysis using fast fourier transformations. Author

N87-21190# Cranfield Inst. of Tech., Bedford (England). Signal Processing and Applications Group.
ACQUISITION AND ANALYSIS OF DYNAMIC ROTATING MACHINERY DATA c37
R. Wallace *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

During the development and design of new engines, vast quantities of vibration data are acquired. An efficient analysis system designed to analyze dynamic rotating machinery data (accels, decels, etc.) is described. The system is built round a general purpose multi-tasking computer which not only analyses the data directly from pre-recorded tapes or rigs but allows engineers to post-analyze data at the same time. Examples of different types of presentation are given which enable easy interpretation of measured data. General acquisition rates and methods are also discussed. Author

N87-21191# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
ACQUISITION AND PROCESSING OF NON-STATIONARY PRESSURE MEASURMENTS IN STUDIES OF AIR INTAKE DISTORTION [ACQUISITION ET TRAITEMENT DES MESURES DE PRESSIONS NON STATIONNAIRES DANS LE CADRE DES ETUDES DE DISTORSION DENTREES DAIR] c37
J. L. Eyraud, F. Auzolle, and M. Wagner (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 7 p In FRENCH (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Investigations of compatibility between an aircraft air intake and the engine constitute an essential stage in the improvement of new concepts. This work is based on an experimental activity which, for full exploitation of the conditions, requires that the most complete data acquisition and processing techniques be employed. The methods described illustrate the full range of presently operational analog and digital systems. Particular emphasis is given to the importance of continuous real time analysis. Author

N87-21192# Royal Aircraft Establishment, Farnborough (England).
DEVELOPMENTS IN DATA ACQUISITION AND PROCESSING USING AN ADVANCED COMBUSTION RESEARCH FACILITY c09
J. B. Bullard, F. S. E. Whitcher, and R. V. Steeden *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 16 p Previously announced as N87-16852 (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

A new combustion rig is described which is designed to acquire rapid and detailed information on the combustion processes occurring within a sector of large annular gas turbine combustors operating over a range of inlet pressures and temperature representative of engine conditions. Gas samples are extracted

using a probe positioned within the volume under examination and transferred to a system designed to perform analyses with a point-to-point cycle time of less than 30 seconds. A computer is used to used to control and synchronize the probe positioning and gas analysis function and to present co-ordinated results to rig controllers. The system is capable of automatic traversing within a prescribed volume or of control by a dummy traverse gear which permits tracing of air and fuel flows. Author

N87-21193# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
DIGITAL IMAGE PROCESSING APPLIED TO FLUID DYNAMIC PROBLEMS c34
J. M. Buchlin *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 10 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Applications of visualization techniques associated with Digital Image Processing in fluid dynamics are discussed. Two typical fluid flow problems of interest for propulsion are selected to illustrate the purpose. The mixing properties of the jet are discussed. Laser tomography and light scattering from micro-droplets of oil lead to the quantification of the three dimensional concentration field. The local heat transfer distribution on a heated surface from oblique and co-liner impinging jets is discussed. Thermographic imaging system is used. Digitized infrared pictures are processed to provide local and average values of the heat transfer coefficients. Author

N87-21194# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
PROCESSING TECHNIQUES FOR CORRELATION OF LDA AND THERMOCOUPLE SIGNALS c35
M. N. R. Nina and G. P. A. Pita *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 8 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

A technique was developed to enable the evaluation of the correlation between velocity and temperature, with laser Doppler anemometer (LDA) as the source of velocity signals and fine wire thermocouple as that of flow temperature. The discontinuous nature of LDA signals requires a special technique for correlation, in particular when few seeding particles are present in the flow. The thermocouple signal was analog compensated in frequency and the effect of the value of time constant on the velocity temperature correlation was studied. Author

N87-21195# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
THE UTILIZATION OF THIN FILM SENSORS FOR MEASUREMENTS IN TURBOMACHINERY [UTILISATION DES CAPTEURS PELLICULAIRES POUR LA MESURE SUR TURBOMACHINES] c37
A. Bruere, M. Portat, J. C. Godefroy, and F. Helias *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 9 p In FRENCH Original language document was announced as A86-46180 (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Sensor features and data analysis principles for thin films used as pressure and temperature transducers for flowfield measurements in turbomachinery are described. The devices were developed to collect data without affecting the flowfield around fixed and rotating turbine blades. The concept has been extended to thermal fluxmeters for measuring convection of the thermoelectric effect and to measuring the aerodynamics of boundary layer flows by exploiting temperature-induced changes in the resistivity of certain metals. The films have a maximum thickness of 80 microns, can be integrated into the walls of the area under investigation by vapor phase deposition, and require adhesive layers of only 2 to 4 microns. Numerical models are furnished for solid and gaseous dielectric sensor films for pressure measurements and for relating data from a thermal fluxmeter to temperature fields of flow. Author

N87-21196# Oxford Univ. (England). Dept. of Engineering Science.
INTERFEROMETRIC MEASUREMENT OF STRAINS AND DISPLACEMENTS IN ENGINE COMPONENTS c37
C. Ruiz, P. H. Webb, and D. Post (Virginia Polytechnic Inst. and State Univ., Blacksburg) *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 13 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The strains and displacements in engine components, and in particular in interlocking joints, have been measured by means of two interferometric methods: (1) high sensitivity Moire interferometry, using gratings with 1200 lines/mm; and (2) a coarser grating of 40 lines/mm. The two methods are described and the results compared to the predictions of a finite element program for a typical dovetail joint. The application of the technique to the assessment of fretting damage and to the lifing dovetail joints is discussed. Author

N87-21197# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
VIBRATION ANALYSIS BY SPECKLE INTERFEROMETRY c39
Hartwig Knoell *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 9 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The vibrational modes of complex systems can be visualized with high sensitivity by laser light speckle interferometry. Electronic speckle pattern interferometry (ESPI), in contrast to holography, does not use photo-chemical storage media but, shows a live image of the vibrational modes created by the time-average method directly on a monitor screen. The particular advantage of this very useful and now almost conventional procedure of vibration analysis is demonstrated by two applications to aero-engine parts: a compressor blade and an impeller of a small centrifugal compressor. Author

N87-21198# Rolls-Royce Ltd., Bristol (England). Advanced Projects Dept.
THE APPLICATION OF RADIATION PHYSICS AND PHOTOGRAMMETRIC TECHNIQUES FOR THE DIAGNOSIS AND SOLUTION OF MECHANICAL ENGINEERING PROBLEMS AND PERFORMANCE IMPROVEMENTS IN THE DEVELOPMENT OF AERO GAS TURBINE ENGINES AT ROLLS ROYCE c37
P. A. E. Stewart *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 19 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Research into the applications of penetrating radiations or particles for the non-invasive imaging and measurement of events within aero gas turbines on dynamic test at Rolls Royce is discussed. High Energy (8 MeV) X-rays are used to determine metal component movements for engine performance improvements and integrity configuration. Low energy X-rays with high speed cine fluoroscopy have been used to analyze molten metal flows in the turbine blade casting process. Cold neutrons and low energy X-rays have been used to analyze two phase flows and oil distribution in the Gem engine oil scavenge system. Positron emitting isotope techniques are being developed to determine fuel and lubrication system dynamics. The images captured by these systems are then processed by digital techniques and pattern recognition and crosscorrelation is carried out. Measurements are made from the film and video images using two and three dimensional photogrammetric methods. Author

N87-21199# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
TIP CLEARANCE MEASUREMENT IN MODERN COMPRESSOR COMPONENTS c37
Hartwig Knoell and Kurt Ding *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 70 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

With regard to maximum efficiency of gas turbine compressors, small blade tip clearances during all engine operating conditions should be achieved. In order to determine the tip clearance during compressor tests, a reliable measuring technique has been developed. Using this temperature-insensitive capacitive probe system (Coulomb system), tip clearance can be monitored even during fast transient conditions. The sensors of the multichannel equipment can operate up to high temperature without cooling. Application to compressor testing is described in two examples; a high-speed centrifugal compressor rig and the intermediate-pressure compressor of a jet engine. Author

N87-21200# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
COMPRESSOR BLADE CLEARANCE MEASUREMENT USING CAPACITANCE AND PHASE LOCK TECHNIQUES c32
Rosario N. Demers *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 10 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The clearance measurement system has several unique features which mimimize problems plaguing earlier systems. These include tuning stability and sensitivity drift. Both these problems are intensified by the environmental factors present in compressors i.e., wide temperature fluctuations, vibrations, and conductive contamination of probe tips. The circuitry in this new system provides phase lock feedback to control tuning and shut calibration to measure sensitivity. The use of high frequency excitation lowers the probe tip impedance, thus miminizing the effects of contamination. A prototype has been built and tested. The ability to calibrate has been demonstrated. An eight channel system is now being constructed for use in the Compressor Research Facility at Wright-Patterson AFB. The efficiency of a turbine engine is to a large extent dependent upon the mechanical tolerances maintained between its moving parts. On critical tolerance is the blade span. Although this tolerance may not appear severe, the impact on compressor efficiency is dramatic. The penalty in percent efficiency has been shown to be three times the percent clearance to blade span ratio. In addition, each percent loss in compressor efficiency represents one half percent loss in specific fuel consumption. Factors which affect blade tip clearance are identified. Author

N87-21201# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
THE STUDY OF COMBUSTION BY MEANS OF DIODE LASER SPECTROSCOPY c36
B. Rosier, P. Gicquel, and D. Henry *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p Original language document was announced as A86-46182 (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

The experimental apparatus and results with a diode laser spectrometer used to obtain absorption signatures of premixed methane-air burning in a furnace are reported. A tunable laser was used to scan the reaction zone with an acuity of 1900 lines/cm. Absorption data collected from the furnace were compared with reference spectra of known gases. Pulse frequencies of 50 Hz to 1 kHz were explored. The data obtained were useful for characterizing the temperatures and composition of the burning gases, identifying the presence of cold layers, and quantifying the mass concentrations of various gases along the flame front. Author

N87-21202# Warwick Univ. Coventry (England). Dept. of Engineering.
THE APPLICATION OF HOLOGRAPHY AS A TRANSONIC FLOW DIAGNOSTIC TO ROTATING COMPONENTS IN TURBOMACHINERY c35
P. J. Bryanston-Cross *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 22 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

A review is presented of the application of holography as a whole field flow visualization diagnostic in turbomachinery. Starting with two dimensional cascade testing, which required wavelength toleranced optical tables, it has now been found possible to obtain results with bolt-on optical components. In order to achieve this, compromises have been made in optical quality and attention has been given to the nature of the data required. Holographic systems are shown which have been applied to visualize the flow in a linear cascade, an annular cascade, a three dimensional compressor shock in a rotating flow and a diffuser blockage observed in a rotating turbocharger. Author

N87-21203# Oxford Univ. (England). Dept. of Engineering.
A STUDY OF PASSAGE FLOW THROUGH A CASCADE OF TURBINE BLADES USING IMAGE PLANE HOLOGRAPHIC INTERFEROMETRY
M. L. G. Oldfield, P. J. Bryanston-Cross (Rolls-Royce Ltd., Derby, England), J. H. Nicholson, and C. T. J. Scrivener *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 12 p Previously announced as N87-15970 (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Holographic interferograms showing the flow through two passages of a cascade of turbine rotor blades in an isentropic light piston tunnel with full-scale Reynolds numbers, Mach numbers, and gas-to-wall temperature ratios are presented. Double exposure absolute and differential image plane holograms of the complete flow field under a range of conditions were obtained. The isodensity contours predicted by a time marching throughflow calculation compare well with the positions of the interference fringe on the holograms. The intersections of these fringes with the blade surfaces give blade surface Mach numbers which agree well with those from surface pressure measurements. Wakes, shock waves, and the presence of upstream and side wall turbulence are all evident in the holograms. Author

N87-21204*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BEAM-MODULATION METHODS IN QUANTITATIVE AND FLOW-VISUALIZATION HOLOGRAPHIC INTERFEROMETRY
Arthur J. Decker *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 16 p Sponsored by NASA (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01 CSCL 20F

Heterodyne holographic interferometry and time-average holography with a frequency shifted reference beam are discussed. Both methods will be used for the measurement and visualization of internal transonic flows where the target facility is a flutter cascade. The background and experimental requirements for both methods are reviewed. Measurements using heterodyne holographic interferometry are presented. The performance of the laser required for time-average holography of time-varying transonic flows is discussed. Author

N87-21205# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
PARTICLE IMAGING VELOCIMETRY IN A LOW TURBULENT WINDTUNNEL AND OTHER FLOW FACILITIES c09
J. Kompenhans and J. Reichmuth *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 13 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

Particle imaging velocimetry (PIV) is a new technique to measure flow velocity and flow direction at one instant in time within a large area of the flow field. For that purpose PIV utilizes the light scattered by small particles in the flow, which are illuminated by two short laser pulses. The experience gained with this method is discussed. Young's fringes method to evaluate the velocity data is discussed. Examples of first experimental results are given. Author

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N87-21206* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MEASUREMENT APPARATUS AND PROCEDURE FOR THE DETERMINATION OF SURFACE EMISSIVITIES Patent

Hans-Juergen C. Blume, inventor (to NASA) Issued 24 Feb. 1987 18 p Filed 3 Dec. 1985 Supersedes N86-24880 (24 - 15, p 2445)

(NASA-Case-LAR-13455-1; US-Patent-4,645,358; US-Patent-Appl-SN-804040; US-Patent-Class-374-9; US-Patent-Class-250-341; US-Patent-Class-374-122) Avail: US Patent and Trademark Office CSCL 20N

A method and apparatus for independently determining the electromagnetic surface emissivity of a material is developed. This is particularly useful in the design of large deployable space antennas employing mesh membrane surfaces. The system is a closed one with respect to unwanted or uncorrelated radiation outside the system. The present embodiment comprises a radiometer connected to a horn antenna, a test section sealed to the horn antenna and a cryogenically cooled matched load (cryoload) exposed to the interior of the system. The material is enclosed in a convection test chamber within a test section, heated within a test chamber and allowed to radiate within the system such that a component of the radiation energy of the material is measured by the radiometer in terms of brightness temperature. The matched load serves as the stabilizing source of uncorrelated radiation within the system by radiating at a constant cryogenic temperature. The actual physical temperature of the material is also measured during the heating process. Brightness temperature over divided by physical temperature for the same time period is the emissivity of the material according to a derivation of the Raleigh-Jeans approximation for an ideal system free from all uncorrelated radiation.

Official Gazette of the U.S. Patent and Trademark Office

N87-21207* National Aeronautics and Space Administration. Pasadena Office, Calif.

SYNCHRONIZATION TRACKING IN PULSE POSITION MODULATION RECEIVER Patent

Victor A. Vilnrotter, 01inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena) Issued 3 Mar. 1987 8 p Filed 7 Aug. 1984 Supersedes N84-32620 (22 - 22, p 3572)

(NASA-Case-NPO-16256-1; US-Patent-4,648,133; US-Patent-Appl-SN-638586; US-Patent-Class-455-608; US-Patent-Class-329-107; US-Patent-Class-375-23; US-Patent-Class-375-110; US-Patent-Class-375-120) Avail: US Patent and Trademark Office CSCL 17B

A clock pulse generator for decoding pulse position modulation in an optical communication receiver is synchronized by a delay tracking loop which multiplies impulses of a data pulse by the square wave clock pulses from the generator to produce positive impulses when the clock pulse is of one level, and negative impulses when the clock pulse is of another level. A delay tracking loop integrates the impulses and produces an error signal that adjusts the delay so the clock pulses will be synchronized with data pulses. A dead-time tau sub d is provided between data pulses of an interval tau sub p in the data pulse period tau. When synchronized, the average number of positive impulses integrated will equal the average number of negative impulses over the continuous stream of data pulses.

Official Gazette of the U.S. Patent and Trademark Office

N87-21208 British Broadcasting Corp., London (England). Engineering Div.

VHF RADIO BROADCASTING: PROPAGATION AND DIVERSITY RECEPTION OF MIXED POLARISED SIGNALS OVER A SEA PATH

D. J. Darlington Mar. 1987 9 p

(BBC-RD-1987/2; RA-227) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

This Report describes measurements of V.H.F. propagation over a 170 km sea path. Statistical analysis of the results provides information about the correlation between horizontally and vertically polarized field components received from an existing mixed (nominally circularly) polarized V.H.F. transmitting station. The possibility of using a polarization diversity reception system, switching between the two field components, for use in low signal level, V.H.F. sea path re-broadcast links, is discussed. It is concluded that polarization diversity provides no significant advantages. Author

N87-21209# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.

COMPUTATIONAL MODEL FOR THE SIMULATION OF MILLIMETER-WAVE PROPAGATION THROUGH THE CLEAR ATMOSPHERE

H. J. Liebe and J. D. Hopponen Oct. 1986 30 p

(PB87-131173; NTIA-86-204) Avail: NTIS HC A03/MF A01 CSCL 20N

Prediction of propagation effects (i.e., path attenuation, phase delay, ray bending, and medium noise) over the 1 to 300 GHz frequency range through the clear, nonturbulent atmosphere is accomplished by combining a spectroscopic data base with a computer program for two-dimensional ray tracing. Interactions between the physical environment and electromagnetic radiation are expressed by a complex refractivity, N. The quantity N is a function of frequency, pressure, humidity, and temperature. Evaluation of path integrals for radio range cumulative attenuation, and noise temperature is accomplished in a rapid manner. Various simulated propagation aspects are presented and details of the treatment of the noise integrals are given. GRA

N87-21210# Royal Signals and Radar Establishment, Malvern (England).

A THEORETICAL STUDY OF CALIBRATION PROCEDURES FOR COHERENT AND NON-COHERENT POLARIMETRIC RADARS

M. A. Wood Jun. 1986 46 p

(RSRE-86011; BR101465; ETN-87-99792) Avail: NTIS HC A03/MF A01

Coherent systems are described in terms of measurement of the scattering matrix and noncoherent systems in terms of the Mueller matrix. The similarity with the calibration of vector reflectometers is emphasized and exploited. Calibration is achieved by measuring the receiver voltages corresponding to scattering of the transmitted states by an odd bounce reflector and appropriately orientated thin wire gratings. ESA

N87-21211# Royal Signals and Radar Establishment, Malvern (England).

A CALIBRTION PROCEDURE FOR A COHERENT POLARIMETRIC RADAR

M. A. Wood May 1986 20 p

(RSRE-MEMO-3889; BR101085; ETN-87-99794) Avail: NTIS HC A02/MF A01

A calibration scheme for a coherent scattering matrix radar to correct for nonideal antenna polarization characteristics and amplitude and phase inbalance between the receiver and transmitter channels is described. Calibration is achieved by measuring the receiver voltages corresponding to scattering the transmitted states from trihedral and dihedral reflectors. Neither the absolute nor relative phase of the calibration targets need to be known. ESA

N87-21212*# Ford Aerospace and Communications Corp., Palo Alto, Calif. Advanced Systems Dept.

THE USE OF SATELLITES IN NON-GEOSTATIONARY ORBITS

FOR UNLOADING GEOSTATIONARY COMMUNICATION SATELLITE TRAFFIC PEAKS. VOLUME 1: EXECUTIVE SUMMARY Final Report, Apr. 1986 - Feb. 1987
K. Price, A. Turner, T. Nguyen, W. Doong, and C. Weyandt May 1987 23 p
(Contract NAS3-24891)
(NASA-CR-179597-Vol-1; NAS 1.26:179597-Vol-1) Avail: NTIS HC A02/MF A01 CSCL 17B

The overall objective of this program was to assess the application, economic benefits, and technology and system implications of satellites in non-geostationary (non-GEO) orbits for off-loading peak traffic from GEO communications satellites. The study was organized into four technical tasks which are described in turn. They are: (1) concepts development; (2) system definition; (3) economic comparisons; and (4) technology requirements definition. Each of these tasks is defined in detail and the results of each are given. Author

N87-21213*# Ford Aerospace and Communications Corp., Palo Alto, Calif. Advanced Systems Dept.
THE USE OF SATELLITES IN NON-GOESTATIONARY ORBITS FOR UNLOADING GEOSTATIONARY COMMUNICATION SATELLITE TRAFFIC PEAKS. VOLUME 2: TECHNICAL REPORT Final Report, Apr. 1986 - Feb. 1987
K. Price, A. Turner, T. Nguyen, W. Doong, and C. Weyandt May 1987 157 p
(Contract NAS3-24891)
(NASA-CR-179597-Vol-2; NAS 1.26:179597-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 17B

The part of the geostationary (GEO) orbital arc used for United States domestic fixed, communications service is rapidly becoming filled with satellites. One of the factors currently limiting its utilization is that communications satellites must be designed to have sufficient capacity to handle peak traffic leads, and thus are under utilized most of the time. A solution is to use satellites in suitable non-geostationary orbits to unload the traffic peaks. Three different designs for a non-geostationary orbit communications satellite system are presented for the 1995 time frame. The economic performance is analyzed and compared with geostationary satellites for two classes of service, trunking and customer premise service. The result is that the larger payload of the non-geostationary satellite offsets the burdens of increased complexity and worse radiation environment to give improved economic performance. Depending on ground terminal configuration, the improved economic performance of the space segment may be offset by increased ground terminal expenses. Author

N87-21214# Naval Research Lab., Washington, D. C.
A QUICK LOOK AT THE FIRST NRL SHORT PULSE 95 GHz RADAR FLIGHT DATA
C. S. Lin and A. C. Miller 12 Dec. 1986 15 p
(AD-A176182; NRL-MR-5891) Avail: NTIS HC A02/MF A01 CSCL 17/7

A new high resolution 95 GHz radar system was incorporated into an existing high speed data acquisition system installed on a NRL RP-3A aircraft. The radar can be operated in either short pulse mode (pulse width 10 nanoseconds) or long pulse mode (pulse width 50 nanoseconds). The high speed data acquisition system can sample the radar return waveforms with total burst rate of up to 500 KHz. A series of measurements was made over the Great Dismal Swamp and the Atlantic Ocean. The radar was deployed in the Altimeter mode during the Dismal Swamp measurements, while both the Altimeter and Aft-looking mode were deployed over the ocean. Representative data are presented. GRA

N87-21215# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
TEST METHODOLOGY FOR ADAPTIVE ANTENNA SYSTEMS
Robert B. Dybdal 30 Jan. 1987 28 p
(Contract F04701-85-C-0086)
(AD-A176295; TR-0086(6925-05)-6; SD-TR-86-103) Avail: NTIS HC A03/MF A01 CSCL 09/5

Conventional antenna evaluations to determine gain, pattern, polarization, and terminal impedance characteristics are conducted on a component level. Adaptive antenna evaluations extend conventional antenna evaluations to system-level tests that quantify the performance of a receiving antenna system in both interference-free and interference environments. Test procedures for conventional antenna evaluations are well established. Test procedures for adaptive antennas expand the scope of antenna testing, tend to be system specific, and represent particular scenarios for interference. Adaptive antenna evaluations require additional instrumentation having more general spectral capabilities than conventional antenna test equipment, as well as an RF measurement facility capable of simultaneously generating both desired and interference signal components arriving from differing directions. The expansion of antenna testing for adaptive antenna designs is reviewed. GRA

N87-21216# Illinois Univ., Urbana. Electromagnetic Communication Lab.
SCATTERING FROM GENERAL PERIODIC SCREENS
Thomas Cwik and Raj Mittra Dec. 1986 167 p
(Contract DAAG29-85-K-0183)
(AD-A176405; UIEC-86-10; UILU-ENG-86-2562; ARO-22634.4-EL) Avail: NTIS HC A08/MF A01 CSCL 20/14

The study of the interaction of waves with periodic structures dates to the late eighteenth century when diffraction gratings were used to separate white light into its spectral orders. At longer wavelengths--from the microwave to the infrared--the shape of the metallic grating, i.e., patch, within each periodic cell characterizes the spectral response of the screen. For patch sizes on the order of the excitation wavelength, a stopband is produced, allowing the periodic screen to act as a filter to the incident field. Applications range from satellite reflector antenna systems to solar collectors, with interesting natural occurrences discovered in the optics of insect compound eyes. This report considers an analysis of periodic screens which allows the study of arbitrarily shaped patches along with the cascading of the patch surfaces with multiple dielectric layers. The formulation is presented for screens which lie between surfaces of a constant variable in the separable rectangular, cylindrical, and spherical coordinate systems. A numerical solution using an iterative technique is outlined for the equations formulated. The patches may be perfectly conducting or lossy to account for resistive materials and the loss associated with metals at infrared wavelengths. GRA

N87-21217# Syracuse Univ., N. Y. Dept. of Electrical and Computer Engineering.
ELECTROMAGNETIC PENETRATION INTO A CONDUCTING CIRCULAR CYLINDER THROUGH A NARROW SLOT, TM CASE Interim Technical Report
Joseph R. Mautz and Roger F. Harrington Dec. 1986 51 p
(Contract DAAG29-84-K-0078)
(AD-A176483; SYRU/DECE/TR-86/4; ARO-21378.8-EL; ITR-6) Avail: NTIS HC A04/MF A01 CSCL 20/3

A procedure is presented for calculating the electromagnetic field in the vicinity of an infinitesimally thin conducting circular cylindrical shell with an infinitely long shot illuminated by a TM plane wave. This field is the short-circuit field plus the field due to the slot. The field due to the slot stems from the axial electric field in the slot. Approximated by a linear combination of expansion functions that satisfy the edge conditions, the latter field is determined by testing the equation of continuity of the tangential magnetic field in the slot with non-negative powers of phi where phi is the angular distance from the center of the slot. Alternative expansion functions are introduced to preserve the accuracy of the solution in the vicinity of an internal resonance. Containing the resonant electric field, the first alternative expansion function is normalized so that its tangential magnetic field remains finite as the resonant frequency is approached. The rest of the alternative expansion functions are orthogonal to the resonant electric field. GRA

N87-21218# Naval Research Lab., Washington, D. C.
PHASE PATTERN OF PHASED ARRAY ELEMENT
J. B. Rao and T. C. Cheston 31 Dec. 1986 16 p
(AD-A176621; NRL-MR-5888) Avail: NTIS HC A02/MF A01 CSCL 20/14

The radiation-phase-pattern of a phased array element was measured to assess performance when used in an array requiring a non-planar phasefront. The E- and H-plane element-phase-patterns were found to give constant phase for scan-angles exceeding 60 deg., but the phase centers were displaced from each other. This separation has to be taken into account when calculating required phase settings for non-planar aperture excitations. GRA

N87-21219# New York Inst. of Tech., Old Westbury.
SCATTERING OF SURFACE WAVES BY NONUNIFORM WAVEGUIDES Final Report
Song-Tsuen Peng 1 Nov. 1986 86 p
(Contract DAAG29-84-K-0006)
(AD-A176632; ARO-21276.2-EL) Avail: NTIS HC A05/MF A01 CSCL 09/1

The scattering of surface waves by nonuniform dielectric waves is systematically investigated, with particular attention directed toward the development of criteria for the design of components and devices for millimeter-wave and integrated-optical applications. The methods of staircase approximation and generalized transmission-line equation are employed for both analytic and numerical analyses. Extensive numerical results are obtained to establish criteria for the design of nonuniform dielectric waveguides. Many useful components and devices, such as: S-curve transition, bends, humps, cracks, waveguide, coupler and directional couplers are investigated in detail. GRA

N87-21220# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE FUNDAMENTALS OF TIMING AND SYNCHRONIZATION FOR DIGITAL COMMUNICATION NETWORKS M.S. Thesis
Robert N. Lorentsen and Richard T. Maloney 25 Jul. 1986 303 p
(AD-A176721; AFIT/CI/NR-87-17T) Avail: NTIS HC A14/MF A01 CSCL 17/2

The telecommunications industry is evolving toward integrated end-to-end digital communications networks. To keep pace with this evolution the telecommunications professional must have a current understanding of digital communications technology. Fundamental to this understanding is the knowledge of timing and synchronization (T and S) for digital communications networks. This assemblage of studies is presented as a reference. It reviews the fundamentals of carrier, bit, and character synchronization. The concept of time as the basic unit for T and S is developed. Time scales, clocks, and frequency sources used in timing systems are discussed. Time and frequency distribution services are described, including LORAN-C and NAVSTAR Global Positioning System (GPS). An explanation of time division multiplexing (TDM) and line codes is given. Network synchronization techniques are examined and classified. GRA

N87-21221# Rome Air Development Center, Griffiss AFB, N.Y.
COMPARISON OF THE EFFECTS OF BROAD-BAND NOISE ON SPEECH INTELLIGIBILITY AND VOICE QUALITY RATINGS Report, for 1 Aug. 1985 - 31 Mar. 1986
Caldwell P. Smith Aug. 1986 38 p
(AD-A176900; RADC-TR-86-135) Avail: NTIS HC A03/MF A01 CSCL 17/2

Results of a study of effects of broad-band noise on speech intelligibility and voice quality are presented, with a comparison of three methods for evaluating speech signals: the Diagnostic Rhyme Test (DRT) for speech intelligibility, the Diagnostic Acceptability Measure (DAM) test for voice quality and acceptability, and the Mean Opinion Score (MOS), also for evaluating speech quality and acceptability. Speech samples were combined with broad-band noise, with accurate calibration of speech-to-noise energy ratios by using a new measurements algorithm developed under RADC sponsorship. Four scrambling (randomizations) of the Diagnostic Rhyme Test were prepared with each of three male speakers, for assessing speech intelligibility. Connected speech samples from the three speakers were prepared for assessing voice quality and acceptability. The processed speech samples were digitally recorded for subsequent presentation to listener crews. Author (GRA)

N87-21222# City Coll. of the City Univ. of New York. Communications Systems Lab.
COMMUNICATIONS USING CHANNELS FORMED BY METEOR BURSTS Annual Technical Report, 1 Jan. - 31 Dec. 1986
Donald L. Schilling and H. J. Kayser 31 Dec. 1986 38 p
(Grant AF-AFOSR-0234-85)
(AD-A176994; AFOSR-87-0088TR) Avail: NTIS HC A03/MF A01 CSCL 17/2

This report discusses the use of the meteor burst channel in communication systems for the United States Air Force. It involves four main areas of research: (1) The development of an accurate and reliable channel model based on recently available empirical data. This results in analytical expressions for communication parameters such as channel duration and throughput, etc., which can be used as design and analysis tools. (2) Evaluation of the performance of various transmission protocols. (3) The optimization and comparison of throughput for fixed and variable transmission rate strategies, subject to a constrained bit error rate. (4) Identification and definition of the basic research challenges that lie in the areas of coding, modulation and networking. Author (GRA)

N87-21223# Los Alamos National Lab., N. Mex.
A STUDY OF THE PROPAGATION OF ULF ELECTROMAGNETIC FIELDS IN COLLISIONAL, INHOMOGENEOUS, MAGNETIZED PLASMAS
J. E. Borovsky Feb. 1987 57 p
(Contract W-7405-eng-36)
(DE87-004768; LA-10839-MS) Avail: NTIS HC A04/MF A01

The propagation of ultralow-frequency (ULF) electromagnetic signals (Alfven and magnetosonic waves) in collisional, inhomogeneous, magnetized plasmas is analyzed by numerical simulation. The problem is formulated from a Maxwell-equation orbit-theory approach rather than from a magnetohydrodynamic point of view, and the problem is numerically treated in a fully time-dependent manner. Boundary-value-problem behavior is distinguished from initial-value-problem behavior. The propagation of two-dimensional small-amplitude electromagnetic disturbances in plasmas with spatially dependent densities and in plasmas with spatially dependent conductivities is numerically simulated, and when possible, the simulations are compared with theory. Changes in the plasma density lead to changes in the signal speed and to reflections; collisions lead to changes in the signal speed, to reflections, and to attenuations. Theoretical descriptions based upon discontinuities in the media are generally incorrect in predicting the amplitudes of signals reflected from plasma inhomogeneities. DOE

N87-21224# Lawrence Livermore National Lab., Calif.
EFFICIENT METHODS FOR EVALUATING THE EFFECTS OF STRESSFUL ELECTROMAGNETIC ENVIRONMENTS ON COMPLEX SYSTEMS
G. C. Corynen Feb. 1986 7 p Presented at the EMC Symposium and Exhibition Special Seminar: EMP Effects on Power Systems, Zurich, Switzerland, 3 Mar. 1987
(Contract W-7405-eng-48)
(DE86-008030; UCRL-94192; CONF-870305-1) Avail: NTIS HC A02/MF A01

An efficient method for evaluating the effects of stressful electromagnetic (EM) environments on complex systems has been developed. Using failure information about the system components, the new method accurately and reliably computes the overall response of systems consisting of hundreds or even thousands of highly interactive components. Quantitative comparisons with current methods are shown and specific applications to

practical large-scale systems are reported, with emphasis on threats due to Electromagnetic Pulse (EMP). DOE

N87-21225# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Systemes et Communications.
MULTISPEAKER NUMBER RECOGNITION Ph.D. Thesis [RECONNAISSANCE MULTILOCUTEUR DES CHIFFRES]
Alain Tassy Apr. 1986 83 p In FRENCH Sponsored by Matra SA, and the Association Nationale pour la Recherche Technique (ENST-86E008; ISSN-0751-1353; ETN-87-99402) Avail: NTIS HC A05/MF A01

A signal processing system was designed and implemented in a model to recognize phonemes emitted by various speakers. The goal is to demonstrate the industrial feasibility of incorporating a speech recognition system in the French PTT Minitel terminal. The algorithm is based on the traditional temporal alignment system. Another method studied is vectorial quantization, which does not use any speech signal temporal data. The system architecture and performance are discussed. ESA

N87-21226# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Systemes et Communications.
ANALYSIS AND RESTITUTION OF VOICE SIGNALS USING EVOLVING MODELS Ph.D. Thesis [ANALYSE ET RESTITUTION DU SIGNAL DE PAROLE PAR MODELS EVOLUTIFS]
Marie-Christine Omnes-Chevalier Jul. 1986 214 p In FRENCH Sponsored by the Association pour le Developpement de l'Enseignement des Communications, and the Ingenieurs et Scientifiques de France
(ENST-86E009; ISSN-0751-1353; ETN-87-99403) Avail: NTIS HC A10/MF A01

Modules to implement a complete analysis-restitution cycle of voice signals were developed. The system is based on the use of evolving models, characterized by a continuous evolution of their coefficients in the sampling interval. The autoregressive evolutionary method is reviewed. The coding of the necessary parameters to obtain the restoration of the signal is discussed. The results show that for 9600 bit/sec input the restitution is excellent. At lower input rates other techniques could be better. ESA

N87-21227# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Reconnaissance and Seeker Systems.
[ACTIVITIES REPORT OF THE DEPARTMENT OF RECONNAISSANCE AND SEEKER SYSTEMS] Annual Report, 1985-1986
J. Kjellgren, S. Abrahamsson, A. Alm, L. Carlsson, O. Carlstedt, P. Grahn, H. Hellsten, H. Lok, L. Mylen, A. Nelander et al Nov. 1986 21 p
(FOA-C-30433-3.1/3.2/3.3/3.4; ISSN-0347-3708; ETN-87-99773) Avail: NTIS HC A02/MF A01; Research Institute of National Defence, Stockholm, Sweden KR50

Research in opto-electronics, radar, and tactical computer support systems for combat control and missile guidance and sensor systems is summarized. ESA

N87-21228# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
GROUND-WAVE ANALYSIS MODEL FOR MF BROADCAST SYSTEMS
N. DeMinco Sep. 1986 74 p
(PB87-124293; NTIA-86-203) Avail: NTIS HC A04/MF A01 CSCL 20N

An automated analysis model is presented for the prediction of system performance of communications circuits that use the ground wave as the primary mode of propagation. The computer program Ground Wave for Voice of America (GWVOA) is a user-friendly program that can predict propagation loss, electric field strength, received power, noise, received signal-to-noise power ratio, and antenna factors over lossy Earth. The smooth-Earth and irregular-Earth propagation loss prediction methods can be used over either homogeneous or mixed paths. A special antenna algorithm is integrated into the computer program for rapid prediction of antenna performance as a function of antenna geometry, ground constants, frequency, and azimuthal direction for a variety of antennas. A description of the computer program GWVOA, a discussion of its capabilities, instructions for its use, and illustrative sample calculations are included in the report.GRA

N87-21229# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
ALGORITHMS USED IN ARROWS: AUTODESIGN OF RADIO RELAY OPTIMUM WIDEBAND SYSTEMS
L. G. Hause Oct. 1986 138 p Sponsored by Army Information Systems Engineering Support Activity
(PB87-126405; NTIA-86-207) Avail: NTIS HC A07/MF A01 CSCL 17B

The report describes the mathematical models used in the ARROWS programs. These programs, which run on a desktop computer, automate the calculation involved in the design of line-of-sight microwave radio relay links. The programs calculate, tabulate, and plot information about Earth geometry, terrain profiles, ray paths, repeater-reflector geometry, median basic transmission loss, variability of loss, equipment effects, and link performance. Each model is selected on the basis of its acceptance within the communications industry and the size and type of data base supporting the model. The computer hardware and software configurations are designed to be convenient to operate and to give the design engineer immediate access to calculated results corresponding to changes in design parameters. The programs corresponding to these algorithms are designed to be used interactively by persons having no experience in programming. The algorithms are applicable over a wide range of link parameters. The frequency range is from 1 GHz to 20 GHz. Path lengths should be less than 150 km. GRA

N87-21230# National Telecommunications and Information Administration, Annapolis, Md.
CALCULATION OF POWER-FLUX DENSITY LEVELS IN THE 2 GHz BAND, PHASE THREE
A. Farrar Jul. 1986 42 p
(PB87-120523; NTIA-86-199) Avail: NTIS HC A03/MF A01 CSCL 17B

The analysis technique developed and discussed in two earlier NTIA reports: Farrar, 1984 (PB85-101244) and Farrar, 1983 (PB84-129402) was used in conjunction with the data obtained from a number of different countries to calculate the power-flux density (pfd) levels in the 2 GHz band. The data included the characteristics of satellites in the space services and fixed service systems in the band. Sharing criteria with other services, such as mobile, are not addressed. GRA

N87-21231# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
RESULTS AND ANALYSIS OF STATIC AND DYNAMIC MULTIPATH IN A SEVERE ATMOSPHERIC ENVIRONMENT
E. Kolton Sep. 1986 101 p Sponsored by Army Information Systems Management Activity
(PB87-131165; NTIA-CR-86-37) Avail: NTIS HC A06/MF A01 CSCL 20N

The analyzed data presented come from several experiments conducted in the Pacific Missile Test Center, Point Mugu, California. The objective of the experiments was to evaluate the performance of digital microwave systems in anomalous propagation conditions. Simultaneous measurements were made of the performance of high bit-rate digital radio systems and the propagation conditions in the radio transmission channels. The transmission channel was monitored with the use of the ITS pseudorandom noise. It is the output data from this PN probe that are analyzed and evaluated in the report. GRA

N87-21200# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
COMPRESSOR BLADE CLEARANCE MEASUREMENT USING CAPACITANCE AND PHASE LOCK TECHNIQUES

Rosario N. Demers *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 10 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N87-21232* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW PHASE NOISE OSCILLATOR USING TWO PARALLEL CONNECTED AMPLIFIERS Patent
Leonard L. Kleinberg Issued 21 Apr. 1987 9 p Filed 14 May 1986 Supersedes N87-14596 (25 - 6, p 764)
(NASA-Case-GSC-13018-1; US-Patent-4,660,000;
US-Patent-Appl-SN-862959; US-Patent-Class-331-56;
US-Patent-Class-331-116-R; US-Patent-Class-331-117-R) Avail: US Patent and Trademark Office CSCL 09A

A high frequency oscillator is provided by connecting two amplifier circuits in parallel where each amplifier circuit provides the other amplifier circuit with the conditions necessary for oscillation. The inherent noise present in both amplifier circuits causes the quiescent current, and in turn, the generated frequency, to change. The changes in quiescent current cause the transconductance and the load impedance of each amplifier circuit to vary, and this in turn results in opposing changes in the input susceptance of each amplifier circuit. Because the changes in input susceptance oppose each other, the changes in quiescent current also oppose each other. The net result is that frequency stability is enhanced.
Official Gazette of the U.S. Patent and Trademark Office

N87-21233* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FOUR QUADRANT CONTROL CIRCUIT FOR A BRUSHLESS THREE-PHASE dc MOTOR Patent
Frank J. Nola, inventor (to NASA) Issued 17 Feb. 1987 13 p Filed 13 Sep. 1985 Supersedes N86-20682 (24 - 11, p 1765)
(NASA-Case-MFS-28080-1; US-Patent-4,644,234;
US-Patent-Appl-SN-775548; US-Patent-Class-318-254;
US-Patent-Class-318-138; US-Patent-Class-318-439) Avail: US Patent and Trademark Office CSCL 09A

A control circuit is provided for a brushless three-phase dc motor which affords four quadrant control from a single command. The control circuit probes acceleration of the motor in both clockwise and counterclockwise directions and braking and generation in both clockwise and counterclockwise directions. In addition to turning on individual transistors of the transistor pairs connected to the phase windings of the motor for 120 deg periods while the other transistor of that pair is off, the control circuit also provides, in a future mode of operation, turning the two transistors of each pair on and off alternately at a phase modulation frequency during such a 120 deg period. A feedback signal is derived which is proportional to the motor current and which has a polarity consistent with the command signal, such that negative feedback results. Official Gazette of the U.S. Patent and Trademark Office

N87-21234* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRECISION TUNABLE RESONANT MICROWAVE CAVITY Patent
Shigeo Nakanishi, inventors (to NASA), Frank S. Calco, inventor (to NASA), and August R. Scarpelli, inventor (to NASA) Issued 10 Feb. 1987 5 p Filed 11 Feb. 1985 Supersedes N85-20248 (23 - 11, p 1628)
(NASA-Case-LEW-13935-1; US-Patent-4,642,523;
US-Patent-Appl-SN-700255; US-Patent-Class-315-111.81;
US-Patent-Class-250-423-R) Avail: US Patent and Trademark Office CSCL 09A

A tunable microwave cavity containing ionizable metallic vapor or gases and an apparatus for precisely positioning a microwave coupling tip in the cavity and for precisely adjusting at least one dimension of the cavity are disclosed. With this combined structure, resonance may be achieved with various types of ionizable gases. A coaxial probe extends into a microwave cavity through a tube. One end of the tube is retained in a spherical joint attached in the cavity wall. This allows the coaxial probe to be pivotally rotated. The coaxial probe is slideable within the tube thus allowing the probe to be extended toward or retracted from the center of the cavity. Official Gazette of the U.S. Patent and Trademark Office

N87-21235* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARATOR WITH NOISE SUPPRESSION Patent
Colossie N. Batts, inventor (to NASA) Issued 24 Mar. 1987 6 p Files 18 Dec. 1984 Supersedes N85-20247 (23 - 11, p 1627)
(NASA-Case-LAR-13151-1; US-Patent-4,652,833;
US-Patent-Appl-SN-683101; US-Patent-Class-328-147;
US-Patent-Class-307-354; US-Patent-Class-307-261;
US-Patent-Class-328-28; US-Patent-Class-328-164) Avail: US Patent and Trademark Office CSCL 09A

An apparatus for generating a single pulse the first time only that a noisy cyclic signal exceeds a reference level during a half-cycle is disclosed. For the positive half of a cycle of the noisy cyclic signal, a comparator and a multivibrator produce a fixed voltage output when the noisy cyclic signal first exceeds the reference level. A multivibrator stops the production of the fixed voltage output when the noisy cyclic signal next passes the zero voltage level in the negative direction. Consequently, a single pulse is generated indicating that the signal exceeded the reference level during that half-cycle. The comparator and multi-vibrator produce pulses whenever the noisy cyclic signal exceeds the reference level during the negative half-cycle.
Official Gazette of the U.S. Patent and Trademark Office

N87-21236# Royal Armament Research and Development Establishment, Fort Halstead (England).
A SOLID STATE TRIGGERED SWITCH FOR EBW FIRING CIRCUITS
R. T. Dedman Feb. 1986 18 p
(RARDE-Memo-6/86; BR99388; ETN-87-99462) Avail: NTIS HC A02/MF A01

The characteristics required of a trigger switch for exploding bridge wire operation are outlined. It is shown that a combination of a silicon controlled rectifier, break over diode, and inverse blocking diode can also be used. Nuclear hardness tests and live firings of the solid state switch are described. ESA

N87-21237# Royal Signals and Radar Establishment, Malvern (England).
BIOLOGICAL MATERIALS FOR INTEGRATED CIRCUITS
J. D. Benjamin and A. L. Mears May 1986 9 p
(RSRE-MEMO-3965; BR100858; ETN-87-99472) Avail: NTIS HC A02/MF A01

The use of biological materials as active components in electronic systems is examined. It is concluded that signal processing is not possible unless their inherently slow switching speed is compensated for by a massive increase in number of elements, which could only be achieved in a cost effective manner if the systems were self organizing. However, as components in sensors they are viable and may also be of use for data storage at very high densities. They may also be of use in the fabrication of conventional integrated circuits through exploitation of their capability to self-organize through highly selective biochemical reactions. ESA

N87-21238# Royal Signals and Radar Establishment, Malvern (England).

RAPID ISOTHERMAL PROCESSING SYSTEMS: AN OVERVIEW
Sukhdev S. Gill Aug. 1986 21 p Original contains color illustrations
(RSRE-MEMO-3967; BR101027; ETN-87-99473) Avail: NTIS HC A02/MF A01

Rapid isothermal processing (RIP) of semiconductor wafers is reviewed. Radiation sources and commercial systems are discussed. It is predicted that RIP will replace conventional furnaces in integrated circuit manufacturing. ESA

N87-21239*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRAVELING-WAVE-TUBE EFFICIENCY IMPROVEMENT BY A LOW-COST TECHNIQUE FOR DEPOSITION OF CARBON ON MULTISTAGE DEPRESSED COLLECTOR
Ben T. Ebihara, Peter Ramins, and Shelly Peet May 1987 14 p
(NASA-TP-2719; E-3416; NAS 1.60:2719) Avail: NTIS HC A02/MF A01 CSCL 09A

A simple method of improving the traveling-wave-tube (TWT) and multistage depressed collector (MDC) efficiency has been demonstrated. The efficiency improvement was produced by the application of a thin layer of carbon to the copper electrodes of the MDC by means of a rapid, low-cost technique involving the pyrolysis of hydrocarbon oil in electric arc discharges. Experimental results with a representative TWT and MDC showed an 11 percent improvement in both the TWT and MDC efficiencies as compared to those of the same TWT and MDC efficiencies with bare copper electrode surfaces. An extended test with a 500-W, continuous wave (CW) TWT and small-sized MDC indicated good stability of the carbon coated electrode surfaces after a relatively small initial degradation in TWT overall and apparent MDC efficiencies. Author

N87-21240# Massachusetts Inst. of Tech., Cambridge. Computer Science Lab.
COMPACTION WITH AUTOMATIC JOG INTRODUCTION
E. M. Maley Nov. 1986 39 p
(AD-A176525; MIT/LCS/TR-372) Avail: NTIS HC A03/MF A01 CSCL 09/5

This thesis presents an algorithm for one-dimensional compaction of VLSI layouts. It differs from older methods in treating wires not as objects to be moved, but as constraints on the positions of other circuit components. These constraints are determined for each wiring layer using the theory of planar routing. Assuming that the wiring layers can be treated independently, the algorithm minimizes the width of a layout, automatically inserting as many jogs in wires as necessary. It runs in time O(n4) on input of size n. Several heuristics are suggested for improving the algorithm's practical performance. The compaction algorithm takes as input a data structure called a sketch, which explicitly distinguished between flexible components (wires) and rigid components (modules). The algorithms first finds constraints on the positions of modules that ensure enough space is left for wires. Next, it solves the system of constraints by a standard graph-theoretic technique, obtaining a placement for the modules. It then relies on a single-layer router to restore the wires to each circuit layer. GRA

N87-21241# Harry Diamond Labs., Adelphi, Md.
COMPARISON BETWEEN CALCULATED AND MEASURED FORWARD AND REVERSE CURRENT-VOLTAGE CHARACTERISTICS Final Report, Oct. 1983 - Sep. 1985
Alford L. Ward and Joanne M. Stellato Nov. 1986 17 p
(AD-A176607; HDL-TR-2099) Avail: NTIS HC A02/MF A01 CSCL 09/1

An investigation is described to better understand the physical processes involved in second breakdown in silicon diodes. Second breakdown is the precursor to burnout of electronic devices and vulnerability of Army electronics. Present methods predicting second breakdown have proven unsatisfactory. In this investigation, experimental measurement of the forward and reverse characteristics of silicon diodes are compared to computer simulations. The objective is to relate the failure threshold of the diode to its parameters and thus be able to design devices less susceptible to burnout. It is shown that the parameters needed to predict second breakdown can be obtained from the low power portions of the device characteristics. Thus low power measurements can be used to screen out susceptible devices. Further work is being done to validate this proposed model. GRA

N87-21242# Naval Research Lab., Washington, D. C.
COSMIC RAY EFFECTS ON MICROELECTRONICS. PART 4 Final Memorandum Report, Oct. 1983 - Oct. 1986
James H. Adams, Jr. 31 Dec. 1986 113 p
(AD-A176611; NRL-MR-5901-Pt-4) Avail: NTIS HC A06/MF A01 CSCL 09/3

Single Event Upset (SEU) vulnerability must be considered in the design of all modern digital electronic systems for use in space. This has resulted in a need to accurately estimate the SEU rate for each type of digital microelectronic component used in the electronic system of any spacecraft on any orbit. This report presents a method of making such estimates. This method considers the effects of device parameters, material shielding, orbital parameters, interplanetary weather conditions, and solar activity. GRA

N87-21243# University of South Florida, Tampa. Dept. of Electrical Engineering.
MACROMODELING OF DIGITAL CIRCUITS Final Report, Apr. - Sep. 1984
Ronald Vogelsong and James Bowers Oct. 1986 173 p
(Contract F30602-81-C-0202)
(AD-A176874; RADC-TR-86-142) Avail: NTIS HC A08/MF A01 CSCL 09/5

As circuit technology advanced into the LSI and VLSI levels, the Air Force's ability to analyze the electromagnetic interference effect on these circuits became very restricted. The purpose of this investigation was to provide greater capabilities for the simulation of electromagnetic interference (EMI) effects on large electrical circuits (particularly logic circuits). This requires an electrical analysis of the entire circuit to fully understand the nature of the problems that can arise when very high frequency interference is injected into what might otherwise be a reasonably straightforward logic analysis. GRA

N87-21244# Battelle Columbus Labs., Ohio.
STUDIES OF MILLIMETER-WAVE DIFFRACTION DEVICES AND MATERIALS. PHASE 3 Final Report, 1 Apr. 1985 - 31 Aug. 1986
Eugene R. Leach, Milton R. Seiler, and Jennifer I. Halman 31 Aug. 1986 30 p
(Contract F49620-85-C-0068)
(AD-A176917; AFOSR-87-0156TR) Avail: NTIS HC A03/MF A01 CSCL 09/5

This study is a continuation of earlier work wherein Battelle examined a variety of diffraction electronics effects. The concept involved is one where a dielectric waveguide interacts with a nearby periodic structure or grating through evanescent mode coupling. By changing the period of the nearby structure, a beam steerable antenna is achieved. The earlier work revealed mechanical, fluidic, and laser-photoconductor ways of achieving a grating containing alternating regions of high- and low- electrical conductively. The center frequency for the past and current work was 94 GHz. This region of the spectrum was selected because discrete phase shifter technology is not sufficiently advanced to permit conventional phased array assembly at this frequency. The diffraction electronics concept offered the potential by-pass of the need for phase shifters, and hence it was necessary to explore the concept for ways to achieve rapid beam steering. GRA

N87-21245# Polytechnic Inst. of New York, Farmingdale.
MILLIMETER WAVE GENERATION BY RELATIVISTIC ELECTRON BEAMS Annual Progress Report, 30 Sep. 1985 - 29 Sep. 1986
S. P. Kuo, K. K. Tiong, and M. H. Whang Jan. 1987 125 p
(Grant AF-AFOSR-0316-85)
(AD-A176949; POLY-WRI-1506-87; AFOSR-87-0113TR) Avail:

NTIS HC A06/MF A01 CSCL 20/3

Progress was achieved in the following five areas: (1) a theory was developed for study of the electron cyclotron maser instability as a mechanism for EM wave generation by relativistic plasmas, (2) a conceptual study was completed on electron beam acceleration by EM radiation, (3) a cusptron microwave tube experiment was designed and fabricated, (4) a theoretical study was completed by induced scattering of a lower hybrid wave by the parametrically excited purely growing density fluctuations into a forward and backward going lower hybrid wave, by the parametrically excited purely growing density fluctuations into a forward and a backward going lower hybrid wave, (5) a self consistent model was developed for electric discharge and the functional dependence of the V-1 characteristics of an arc and the onset process of arc construction on thermal properties. GRA

N87-21246# Boeing Military Airplane Development, Seattle, Wash.
FAULT TOLERANT ELECTRICAL POWER SYSTEM. PHASE 1: STUDY Interim Technical Report, Apr. - Jun. 1985
Mark W. Dige, Patrick J. Leong, and David L. Sommer Dec. 1986 52 p
(Contract F33615-85-C-2504)
(AD-A177061-Ph-1; D180-28576-2-Ph-1; AFWAL-TR-86-2084-1-Ph-1) Avail: NTIS HC A04/MF A01 CSCL 01/3

The objectives of this program are to develop a fault tolerant electrical power system (FTEPS) design for an ATF aircraft and to design and fabricate a low cost FTEPS demonstrator with an integrated load simulator. The primary purpose of the program is to develop an electrical power generation and distribution system that can supply electrical power to the various critical systems on the aircraft with a reliability and power quality level commensurate with the requirements of the loads. In Phase 1, the electrical loads and their power requirements were defined for the ATF baseline aircraft model. The loads were also located in the baseline aircraft model. GRA

N87-21247# Polytechnic Inst. of New York, Farmingdale.
BASIC RESEARCH IN ELECTRONICS: JOINT SERVICES ELECTRONICS PROGRAM (JSEP) Annual Report, 1 Jan. - 31 Dec. 1986
Arthur A. Oliner and Erich E. Kunhardt 31 Dec. 1986 127 p
(Contract F49620-85-C-0078)
(AD-A177067; POLY-WRI-1505-86; AFOSR-87-0090TR) Avail: NTIS HC A07/MF A01 CSCL 09/3

This report presents a summary of the scientific progress and accomplishments on research projects by the Joint Services Electronics Program (JSEP) for the contract periods from 1 January 1986 through 31 December 1986. It does not contain information regarding accomplishments on research projects funded in other ways. The Joint Services Electronics Program at the Polytechnic is the core of interdisciplinary research in electronics encompassing programs in the Departments of Electrical Engineering, Physics and Chemistry under the aegis of the Weber Research Institute. The research encompassed by this program is grouped under three broad categories: electromagnetics, solid state electronics and information electronics. GRA

N87-21248# Argonne National Lab., Ill.
PROCEEDINGS OF THE INTERNATIONAL WORKSHOP ON HIGH-TEMPERATURE MOLTEN SALT BATTERIES
1986 239 p Workshop held in Argonne, Ill., 16 Apr. 1986
(Contract W-31-109-eng-38)
(DE87-003297; ANL-86-40; CONF-8604116) Avail: NTIS HC A11/MF A01

Twenty-six papers are presented in three sessions, titled: basic properties of molten salt battery systems, engineering development of lithium-alloy/metal sulfide batteries; and research and development in molten salt systems. Individual papers are abstracted separately for the data base. DOE

N87-21249# Argonne National Lab., Ill.
BATTERY THERMAL MODELING: THE METHODOLOGY AND APPLICATIONS
J. Lee 24 Oct. 1986 10 p Presented at the Electrochemical Society Fall Meeting, San Diego, Calif., 19 Oct. 1986
(Contract W-31109-eng-38)
(DE87-004865; CONF-861068-15) Avail: NTIS MF A01

Mathematical modeling has been an efficient and powerful tool for evaluating thermal behavior of batteries and electrochemical cells. In this paper, the methodology and applications of thermal modeling in various battery systems are reviewed. Potential needs and extensions of battery thermal modeling are discussed. DOE

N87-21250# Communications Satellite Corp., Clarksburg, Md. COMSAT Labs.
DESIGN AND DEVELOPMENT OF A MULTI-KILOWATT HOUR HYDROGEN/NICKEL OXIDE BATTERY
J. Dunlop, M. Earl, M. Brown, H. Vaidyanathan, W. Gentry (Johnson Controls, Inc., Milwaukee, Wis.), R. Beauchamp, and J. Sindorf Jan. 1987 124 p Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE87-006774; SAND-87-7061) Avail: NTIS HC A06/MF A01

Work continued to develop a sealed, hydrogen/nickel oxide battery for deep discharge, 20-year life, terrestrial energy storage applications that would be cost-competitive with lead-acid batteries. The latest battery delivered to Sandia has five individual prismatic cells in a common pressure vessel; the cells are connected in series resulting in a nominal six volts. Thicker positive electrodes developed during the contract increased the capacity of the cells from about 100 Ah to 145 Ah. DOE

N87-21251# Maryland Univ., College Park.
GRAPHITE AS A PICOSECOND LASER ACTIVATED OPENING SWITCH
E. A. Chauchard, C. H. Lee, C. Y. Huang (Los Alamos National Lab., N. Mex.), and A. M. Malvezzi (Harvard Univ., Cambridge, Mass.) 1987 5 p Presented at the IEEE/OSA Topical Meeting on Picosecond Electronics and Optoelectronics, Lake Tahoe, Nev., 14 Jan.1987 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE87-003758; LA-UR-86-4352; CONF-870114-2) Avail: NTIS HC A02/MF A01

Highly Oriented Pyrolytic Graphite exhibiting a high conductivity in the dark and a high resistivity when illuminated by intense laser light was used as an opening switch. DOE

N87-21252# Lawrence Livermore National Lab., Calif.
ALUMINUM-AIR BATTERY CRYSTALLIZER
A. Maimoni 23 Jan. 1987 24 p Presented at the American Institute of Chemical Engineers Spring National Meeting, Houston, Tex., 29 Mar. 1987
(Contract W-7405-eng-48)
(DE87-005839; UCRL-95923; CONF-870323-3) Avail: NTIS HC A02/MF A01

A prototype crystallizer system for the aluminum-air battery operated reliably through simulated startup and shutdown cycles and met its design objectives. The crystallizer system allows for crystallization and removal of the aluminium hydroxide reaction product; it is required to allow steady-state and long-term operation of the aluminum-air battery. The system has to minimize volume and maintain low turbulence and shear to minimize secondary nucleation and energy consumption while enhancing agglomeration. A lamella crystallizer satisfies system constraints. DOE

N87-21253# Istituto Elettrotecnico Nazionale (Galileo Ferraris), Turin (Italy).
[ACTIVITIES REPORT IN ELECTRICAL TECHNOLOGY] Annual Report, 1985
May 1986 164 p
(ETN-87-99354) Avail: NTIS HC A08/MF A01

Research in acoustics; electromechanics; photometry; systems engineering; materials science; electrical metrology; time,

frequency, and electromagnetic metrology; and television is summarized. ESA

N87-21254# National Academy of Sciences - National Research Council, Washington, D. C.
PAPERS PRESENTED AT A WORKSHOP ON ELECTRIC ENERGY SYSTEMS RESEARCH Final Report
1986 358 p Workshop held in Washington, D.C., 24-26 Apr. 1985
(Contract DE-AC01-84CE-90142)
(PB87-137238) Avail: NTIS HC A16/MF A01 CSCL 09C

The general purpose of the Workshop on Electric Energy Systems Research was to help the Committee on Electric Energy Systems understand the range of complex R and D problems and decisions relating to the future of electric energy systems. These include: (1) advanced systems technology involving new materials concepts and components; (2) reliability involving (a) the use of communications and computer technology for normal and emergency operations, and (b) the special national defense contingencies associated with an electromagnetic pulse from a nuclear device explosion in the atmosphere; and (3) environmental impacts related to the effects and magnetic fields induced by high voltage transmission lines. The specific objectives of the workshop were to: (1) identify research topics of national importance; (2) determine the appropriate federal role vis-a-vis the private sector; and (3) critique the current and planned EES program in the light of these considerations. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N87-21255* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LIQUID SEEDING ATOMIZER Patent
Henry L. B. Seegmiller, inventor (to NASA) Issued 10 Mar. 1987 7 p Filed 31 Mar. 1986 Supersedes N86-24935 (24 - 15, p 2454)
(NASA-Case-ARC-11631-1; US-Patent-4,648,267; US-Patent-Appl-SN-846426; US-Patent-Class-73-147; US-Patent-Class-239-426; US-Patent-Class-239-434; US-Patent-Class-239-545) Avail: US Patent and Trademark Office CSCL 20D

An atomizer for a liquid having an air supply is described. Liquid supply tubes extend longitudinally along the air supply tube. The air supply tube has at least one air orifice extending from an inner surface of the tube through the tube. The liquid supply tubes are positioned on either side of the air orifices and the liquid tubes are sealed to the air supply tube. The liquid supply tubes with facing liquid orifices are positioned adjacent to each of the air orifices. The liquid supply tubes are laterally spaced apart at the liquid orifices at a distance less than the diameter of the air orifices to enable a beneficial venturi effect when the atomizer is in operation.

Official Gazette of the U.S. Patent and Trademark Office

N87-21256 Iowa Univ., Iowa City.
COMPUTER-AIDED ANALYSIS OF TWO-DIMENSIONAL LAMINAR AND TURBULENT INCOMPRESSIBLE FLOWS Ph.D. Thesis
Mohamad Zahed Sheikholeslami 1986 323 p
Avail: Univ. Microfilms Order No. DA8622810

A new finite analytic (FA) numerical solution is obtained for the governing equations of two-dimensional incompressible laminar and turbulent flows. In obtaining the numerical solution the FA method is modified by introducing a new boundary function, a piecewise constant-exponential function for the finite analytic element. The finite analytic solutions obtained from this improved formulation is compared to other existing numerical solutions for some benchwork convection-diffusion equations. It is found that the FA method is a stable numerical method in that the new FA solution never exhibits over or under-shoot due to numerical approximation of the governing partial differential equations. In addition to the new boundary function, a new linearizing scheme for the convective term is proposed for solving the general convection-diffusion equation including the Navier-Stokes equations. This linearization scheme employs the idea of upwinding by selecting a point in the FA element whose velocity can best represent the convective velocity over the whole element. The FA method developed herein is used to predict several turbulent flows. Dissert. Abstr.

N87-21257*# United Technologies Research Center, East Hartford, Conn. Experimental Gas Dynamics Group.
FLOWFIELD MEASUREMENTS IN A SEPARATED AND REATTACHED FLAT PLATE TURBULENT BOUNDARY LAYER Final Report
William P. Patrick Washington NASA Mar. 1987 245 p
(Contract NAS3-22770)
(NASA-CR-4052; E-3254; NAS 1.26:4052) Avail: NTIS HC A11/MF A01 CSCL 20D

The separation and reattachment of a large-scale, two-dimensional turbulent boundary layer at low subsonic speed on a flat plate has been studied experimentally. The separation bubble was 55 cm long and had a maximum bubble thickness, measured to the height of the mean dividing streamline, of 17 cm, which was twice the thickness of the inlet boundary layer. A combination of laser velocimetry, hot-wire anemometry, pneumatic probing techniques, and flow visualization were used as diagnostics. Principal findings were that an outer inviscid rotational flow was defined which essentially convected over the blockage associated with the inner, viscously dominated bubble recirculation region. A strong backflow region in which the flow moved upstream 100 percent of the time was measured near the test surface over the central 35 percent of the bubble. A laminar backflow boundary layer having pseudo-turbulent characteristics including a log-linear velocity profile was generated under the highly turbulent backflow. Velocity profile shapes in the reversed flow region matched a previously developed universal backflow profile at the upstream edge of the separation region but not in the steady backflow region downstream. A smoke flow visualization movie and hot-film measurements revealed low frequency nonperiodic flapping at reattachment. However, forward flow fraction data at reattachment and mean velocity profiles in the redeveloping boundary layer downstream of reattachment correlated with backward-facing step data when the axial dimension was scaled by the distance from the maximum bubble thickness to reattachment. Author

N87-21258# Atomic Weapons Research Establishment, Aldermaston (England).
THE VARIATION OF PRESSURE ON THE GROUND WITH HEIGHT OF BURST OF HIGH EXPLOSIVE CHARGES
Winifred E. Worsfold, N. J. M. Rees, and D. E. J. Samuels Sep. 1986 26 p
(AWRE-O-9/86; BR-100481; ETN-87-99461) Avail: NTIS Avail: NTIS HC A03/MF A01

Over 240 charges of RDX/TNT 60/40, each a sphere of 8 lb 10 oz, were fired at heights from 3 in. to 40 ft above a level concrete surface. Overpressures were recorded by quartz crystal gages mounted from 1.5 to 5.5 in. above the ground, at distances from 15 to 85 ft from Ground Zero. A set of curves of height of burst versus peak pressure, and height of burst versus ground range, are given for peak overpressures from 2 to 30 psi. ESA

N87-21259*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TOWARD THE LARGE-EDDY SIMULATIONS OF COMPRESSIBLE TURBULENT FLOWS Final Report
G. Erlebacher, M. Y. Hussaini, C. G. Speziale, and T. A. Zang Mar. 1987 39 p Submitted for publication

(Contract NAS1-18107)
(NASA-CR-178273; ICASE-87-20; NAS 1.26:178273) Avail: NTIS HC A03/MF A01 CSCL 20D

New subgrid-scale models for the large-eddy simulation of compressible turbulent flows are developed based on the Favre-filtered equations of motion for an ideal gas. A compressible generalization of the linear combination of the Smagorinsky model and scale-similarity model (in terms of Favre-filtered fields) is obtained for the subgrid-scale stress tensor. An analogous thermal linear combination model is also developed for the subgrid-scale heat flux vector. The three dimensionless constants associated with these subgrid-scale models are obtained by correlating with the results of direct numerical simulations of compressible isotropic turbulence performed on a 96 to the third power grid using Fourier collocation methods. Extensive comparisons between the direct and modeled subgrid-scale fields are provided in order to validate the models. Future applications of these compressible subgrid-scale models to the large-eddy simulation of supersonic aerodynamic flows are discussed briefly. Author

N87-21260# Aeronautical Research Labs., Melbourne (Australia).
VISCOUS FLOW AROUND WALL MOUNTED OBSTACLES
W. H. Schofield and E. Logan (Arizona State Univ., Tempe) Sep. 1986 89 p
(ARL-AERO-PROP-REPT-172; AR-004-499) Avail: NTIS HC A05/MF A01

The flow field surrounding obstacles attached to a wall under a turbulent boundary layer is analyzed. The analysis concentrates on how major features of the flow are influenced by model geometry and parameters of the incident boundary layers. Experimental data are analyzed in terms of nondimensional variables chosen on the basis that their effect on major flow features can be simply appreciated. Flow around two and three-dimensional objects are studied, singly and in groups, on smooth and rough walls, in boundary layer and pipe flow. The only restriction applied to the data is that the shear layer approaching the obstacle should be thicker than the height of the obstacle. This work shows that flow data from a wide range of flows can be collapsed if the appropriate nondimensional scales are used and, that the rate of recovery at any point downstream of a prism depends mainly on its relative proximity to the streamwise vortices in the flow. Numerous other particular conclusions are drawn. Author

N87-21261# Naval Postgraduate School, Monterey, Calif.
A CORRELATION FOR THE HEAT TRANSFER COEFFICIENT IN A RECTANGULAR PASSAGE CONTAINING PROTUBERANCE M.S. Thesis
Ceyhun Cesur Sep. 1986 58 p
(AD-A176111) Avail: NTIS HC A04/MF A01 CSCL 20/13

An experimental investigation was carried out to determine the effect on the convective heat transfer coefficient of protuberances in a rectangular passage. A cross flow compact type heat exchanger formed by several parallel spaced plates including protuberances was tested by using water, glycol and air as a working fluids. Heat transfer coefficient data was obtained by measuring mass flow rate, temperature and pressure drops across the heat exchanger. Heat transfer characteristics are discussed and correlations for Nusselt number, Colburn factor and friction factor have been obtained. GRA

N87-21262# Fluid Dynamics International, Inc., Evanston, Ill.
FINITE ELEMENT CALCULATIONS OF VISCOELASTIC FLUID FLOW IN A SPINNING AND NUTATING CYLINDER Contractor Report, Jan. 1985 - Apr. 1986
S. Rosenblat, A. Gooding, and M. S. Engleman Dec. 1986 102 p
(Contract DAAK11-85-C-0012)
(AD-A176297; CRDEC-CR-87021) Avail: NTIS HC A06/MF A01 CSCL 20/4

An investigation has been performed of the flow of a non-Newtonian liquid in a spinning and nutating cylinder. An approximate analysis has been effected on the assumption that the ratio of coning rate to spin rate is small and applied to the case of a cylinder of infinite length. A numerical calculation has been performed for the actual flow of two specified non-Newtonian liquids, using the finite element code FIDAP. Results are presented in both graphical and tabular form showing flow fields and calculated values of the despin moment for ranges of parameters. The question of appropriate representation of the liquid's non-Newtonian behavior is discussed. GRA

N87-21263# Scientific Research Associates, Inc., Glastonbury, Conn.
SOLUTION OF THE THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS FOR A TURBULENT HORSESHOE VORTEX FLOW Final Report, 1 Oct. 1985 - 30 Sep. 1986
R. C. Buggelin, W. R. Brilery, and H. McDonald Jan. 1987 36 p
(Contract N00014-85-C-0420)
(AD-A176370; SRA-R87-920027-F) Avail: NTIS HC A03/MF A01 CSCL 20/4

The problem of three dimensional turbulent horseshoe vortex/corner flow is investigated numerically. Solutions of the compressible Reynolds averaged Navier Stokes equations are computed using a linearized block implicit scheme with Douglas Gunn splitting. Solutions are computed using both two equation (k-epsilon) and algebraic mixing length turbulence models, with grid distributions which provide resolution of the viscous sublayer regions. These computed results are displayed graphically and compared with recent experimental measurements. There is good qualitative agreement between computed and measured mean flow velocities, especially near the saddle point separation line. The computed corner flow has a multiple vortex structure. There are quantitative differences in details of the weak corner flows downstream of the leading edge, which may be attributable to the turbulence model used and/or numerical error. Convergence required approximately 150 iterations using a 60x50x40 grid (120,000 points) and required about 2.5 hours of CRAY-XMP run time. GRA

N87-21264# Scientific Research Associates, Inc., Glastonbury, Conn.
NUMERICAL STUDY OF THREE-DIMENSIONAL LAMINAR AND TURBULENT FLOWS WITH SYSTEM ROTATION Final Report, 1982 - 1986
W. R. Briley, T. R. Govindan, R. Levy, and H. McDonald Dec. 1986 46 p
(Contract DAAG29-82-C-0021)
(AD-A176546; ARO-19149.2-EG-S) Avail: NTIS HC A03/MF A01 CSCL 20/4

The spatial marching analysis is given for economical computation of three-dimensional viscous subsonic flows in rotating geometries. The governing equations are based on a small scalar potential approximation for the vector decomposed secondary flow velocity. No approximation is needed for the streamwise pressure gradient term and this allows strong viscous secondary flows, coordinate curvature and system rotation effects to influence these pressure gradients. This approach is applied to three-dimensional laminar and turbulent flows in rotating 90 degree bends and in rotating straight pipes and ducts. The predicted structure of these flows is consistent with experimental observations and measurements. Computer solutions obtained using 500,000 grid points require only about 15 minutes of CRAY-1S run time. This approach appears promising for further development and application to centrifugal impeller and other turbomachinery flows. GRA

N87-21265# Naval Postgraduate School, Monterey, Calif.
TRANSONIC COMPRESSOR BLADE TIP FLOW VISUALIZATION ON A WATER TABLE M.S. Thesis
Alan K. Byrd Dec. 1986 58 p
(AD-A176592) Avail: NTIS HC A04/MF A01 CSCL 20/4

The shock structure at the tip of a transonic compressor rotor was investigated on a water table. A four bladed cascade model was used and the wave pattern was examined at variable incidence, flow turning angles and back-pressures. Froude numbers, (equivalent to Mach numbers in the analogous two dimensional gas flow), in the range 1.6 to 1.74 resulted in an oblique shock between the

blade passages starting from the leading edge pressure side of the blading. Qualitative agreement of the shock structure with earlier tests using the same blading in a transonic blow-down tunnel was observed, leading to the conclusion that the shock present in the compressor would be oblique and not normal as was previously assumed. GRA

N87-21266# Naval Research Lab., Washington, D. C.
VORTICITY GENERATION BY SHOCK PROPAGATION THROUGH BUBBLES IN AIR
J. M. Picone and J. P. Boris 14 Nov. 1986 34 p
(AD-A176610; NRL-MR-5884) Avail: NTIS HC A03/MF A01 CSCL 20/4

We use numerical solutions of the fluid equations for conservation of mass, momentum, and energy to study the interaction of a planar shock with a local, discrete inhomogeneity in the ambient medium. We study the effects of both geometry and distortion of the local sound speed by considering the nonuniformity to be a cylindrical of spherical bubble which has either a higher or lower density than the ambient gas. The Mach number of the shock is 1.2, the ambient gas is air, and the pressure is 1 atmosphere. The passage of the shock through a bubble generates vorticity at the boundary of the bubble. This vorticity produces a jet of ambient gas through the bubble, and as a consequence, the vorticity rolls up into a vortex filament pair (cylindrical bubble) or a vortex ring (spherical bubble). We discuss the theoretical treatment of this nonlinear interaction of the vorticity with itself and the relationship of our work to other theories. We relate our results to recent experiments of Haas and Sturtevant, in which helium and freon bubbles were used to simulate the local departures from ambient density. GRA

N87-21267# Naval Postgraduate School, Monterey, Calif.
STABILITY OF THE VORTEX MOTION IN OSCILLATING FLOW M.S. Thesis
William T. McCoy Dec. 1986 111 p
(AD-A176629) Avail: NTIS HC A06/MF A01 CSCL 20/4

Previous investigations have shown that the characteristics of flow about a circular cylinder immersed in a time-dependent flow exhibit cycle-to-cycle variations. These variations have been attributed to variations in the spanwise coherence, aspect ratio, nonuniformity of the flow, and random disturbances in the ambient flow. A theoretical investigation was undertaken to examine the stability of the flow characteristics in terms of the initial state of the vortices. An idealized model was devised and the position of the vortex was varied systematically. Results show that finite-precision information about the characteristics of the flow does not lead to finite-precision information at a later stage. In fact, advection of the vortices can give rise to chaotic behavior in the calculated lift and drag forces and in the velocity field. It is concluded that the cycle-to-cycle variations are not entirely due to lack of spanwise coherence and that they are mostly a lack of spanwise coherence and a consequence of the chaotic motion which can result from advection of the vortices in a time-dependent flow. GRA

N87-21268# Applied Research Lab., State College, Pa.
WAVEVECTOR-FREQUENCY SPECTRUM OF TRANSITION ZONE WALL PRESSURE FLUCTUATIONS Ph.D. Thesis
M. A. Josserand and G. C. Lauchle Dec. 1986 184 p
(AD-A176655; ARL/PSU/TR-86-008) Avail: NTIS HC A09/MF A01 CSCL 20/4

The laminar to turbulent transition zone continues to be of interest from the flow noise point of view. A theoretical model was developed to predict the radiated component (wavenumber less than or equal to the sonic wavenumber) of the pressure fluctuations that occur in this zone. It is also recognized that wavenumbers greater than the sonic wavenumber are also important because pressure fluctuations at these higher wavenumbers may couple with structural vibrations. GRA

N87-21269# Naval Postgraduate School, Monterey, Calif.
VORTEX MOTION IN A STRATIFIED MEDIUM M.S. Thesis
Brian S. Miller Dec. 1986 235 p
(AD-A176729) Avail: NTIS HC A11/MF A01 CSCL 20/4

A comprehensive computer code has been developed through the use of the governing equations of motion and the Boussinesq hypothesis and the rise of a vortex pair in a linearly density stratified medium has been calculated through the use of the Boit Savart law and a finite difference scheme. The results have shown that the code is capable of predicting the behavior of the vortices and the propagation of the internal waves resulting from the vortex motion. The reasons for the finite rise of the vortices in a stratified medium is clearly explained in terms of the counter-rotating vortices induced by the stratification. GRA

N87-21270# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
FLOW INDUCTION BY ROTARY JETS Final Report, 1 Mar. 1980 - 31 Aug. 1984
Charles A. Garris and Joseph V. Foa 1986 26 p
(Contract F49620-80-C-0043)
(AD-A177013; AFOSR-87-0049TR) Avail: NTIS HC A03/MF A01 CSCL 21/5

Theoretical analyses of generalized flow induction were carried out which showed that the least dissipative mode of flow induction is the cryptosteady mode. Studies were carried out on the energetics of vortex formation showing that in pulsatile thrust augmentors, considerable energy is carried away as kinetic energy of rotation. Parametric studies were conducted on rotary-jet thrust augmentation yielding a best thrust augmentation of 1.97. Theoretical and experimental studies on the utilization of propagating stall were conducted. The promise of eliminating moving parts for the rotary-jet thrust augmentor was explored and parametric testing was conducted to establish conditions for obtaining stall. Experiments showed, however, that stall is relatively difficult to obtain in configurations compatible with the rotary jet thrust augmentor. GRA

N87-21271# Dayton Univ., Ohio.
NUMERICAL SIMULATION OF COMPRESSIBLE NAVIER-STOKES FLOW IN A DOUBLE THROAT NOZZLE Final Report, 1 Jan. - 31 Dec. 1985
James N. Scott Jun. 1986 128 p
(Grant AF-AFOSR-0032-85)
(AD-A177023; UDR-TR-86-44; AFOSR-87-0065TR) Avail: NTIS HC A07/MF A01 CSCL 20/4

Flow through a double throat nozzle has been computed for Reynolds numbers by 100, 400 and 1,600 on three different grid sizes. The computations were performed using a modified two-dimensional version of Shang's Navier Stokes code which employs MacCormak's explicit finite difference algorithm. The computations establish a benchmark against which new developments can be verified and also add to the growing confidence in this approach for applications to more complex flow situations. GRA

N87-21272# Oxford Univ. (England). Dept. of Engineering Science.
WAKE INTERACTION EFFECTS ON THE TRANSITION PROCESS ON TURBINE BLADES Annual Scientific Report, 1 Sep. 1985 - 31 Aug. 1986
30 Oct. 1986 28 p
(Grant AF-AFOSR-0295-85)
(AD-A177094; AFOSR-87-0108TR; ASR-1) Avail: NTIS HC A03/MF A01 CSCL 20/4

Wide bandwidth (100 kHz) heat transfer instrumentation was used to make detailed time resolved measurements on a two dimensional gas turbine rotor cascade blade surface under the influence of simulated unsteady wake and shock passing events. The instrumentation was capable of detecting and tracking naturally occurring transitional turbulent spots confirming the classical model of boundary layer transition. In addition instantaneous large excursions in the surface heat transfer were observed as the simulated wake shock structure from a transonic nozzle guide wave passed over the rotor cascade. The transitional behavior of the blade boundary layer was seen to depend primarily on free

stream turbulence and Reynolds number and, away from the direct interaction region, to be relatively unaffected by the wake/shock induced disturbances. GRA

N87-21273# Transamerica Delaval, Inc., Trenton, N.J. Biphase Energy Systems Div.
ALTERNATIVE FLOW CONTROL NOZZLES/ENERGY DISSIPATION OF HIGHLY EROSIVE FLUIDS Final Report
P. Maddox Sep. 1986 108 p
(Contract DE-AC21-86MC-22250)
(DE87-001025; DOE/MC-22250/2215) Avail: NTIS HC A06/MF A01

An innovative Flow Control Device (FCD) utilizing multiple pairs of opposed coaxially-aligned nozzles was successfully tested in a three-phase erosive-flow stream. A mixture of air, water, and silica was selected to produce velocities representative of those resulting in a high-pressure letdown coal-liquefaction process. Aluminum was utilized for test hardware to provide accelerated erosion data. A globe valve with aluminum trim was tested at the same operating conditions to provide baseline performance data for direct comparison with nozzle results. The time rate of increase in flow-control area of the FCD was less than one third that of the globe valve. This demonstrates the relative severity of impingement erosion over scouring erosion, as there are no abrupt directional changes in the nozzle flow. The receiver walls showed no erosion damage for liquid levels well below the nozzle exit, indicating very efficient energy dissipation in the jet-impact zone. These favorable results coupled with the design simplicity of the FCD provides a solid basis for further development. DOE

N87-21274# Lawrence Livermore National Lab., Calif.
TURBULENT ENERGY GENERATED BY ACCELERATIONS AND SHOCKS
K. O. Mikaelian Oct. 1986 12 p Presented at the 3rd International Conference on Stratified Flows, Pasadena, Calif., 3 Feb. 1987
(Contract W-7405-eng-48)
(DE87-002377; UCRL-95582; CONF-870235-1) Avail: NTIS HC A02/MF A01

The turbulent energy generated at the interface between two fluids undergoing a constant acceleration or a shock is calculated. Assuming linear density profiles in the mixed region we find E sub turbulent/ E sub directed = 2.3A sq % (constant) acceleration) and 9.3A sq % (shock), where A is the Atwood number. Diffusion models predict somewhat less turbulent energy and a density profile with a tail extending into the lower density fluid. Eddy sizes are approximately 27% (constant acceleration) and 17% (shock) of the mixing depth into the heavier fluid. DOE

N87-21275# Los Alamos National Lab., N. Mex.
CONVECTIVELY DRIVEN SUPERFLUID TURBULENCE IN DILUTE SOLUTIONS OF He3 IN SUPERFLUID He4
R. E. Ecke, H. Haucke, and J. Wheatley Oct. 1986 25 p Presented at the Conference on Quantum Fluids and Solids, Banff, Canada, 13 Oct. 1986
(Contract W-7405-eng-36)
(DE87-002918; LA-UR-86-3785; CONF-8610184-1) Avail: NTIS HC A02/MF A01

A dilute solution of (3)He in superfluid (4)He usually behaves as a single component classical fluid in the context of hydrodynamic convection. However, certain convective states can be excited which do not seem to exist in classical convection. These states are characterized by noisy temperature fluctuations and a pronounced decrease in thermal conductance relative to the classical convecting states. Critical convective flow fields are observed analogous to critical velocities for superfluid turbulence in pipes. The magnitude of the average critical velocities for these two types of superfluid turbulence are in good agreement. Also, a quantitative estimate of energy dissipation due to the interaction of normal fluid and quantized vortex lines appears to account for the large decrease in thermal heat transport for the turbulent states. These states are identified as states of convectively driven superfluid turbulence. DOE

N87-21276# Virginia Polytechnic Inst. and State Univ., Blacksburg.
HEAT TRANSFER IN OSCILLATORY FLOW Final Report
D. P. Telionis and T. E. Diller Nov. 1986 31 p
(Contract DE-AS05-82ER-12022)
(DE87-004374; DOE/ER-12022/1) Avail: NTIS HC A03/MF A01

This is the final report on a 4-year research effort funded by DOE. The bulk of the material has been included in numerous publications which are listed in a later section. Most of these have appeared already in archival journals. The most recent work is included in two Ph.D. dissertations. Since most of the material is already documented in detail in the publications mentioned above, we confine the discussion here to highlights of the results. DOE

N87-21277# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
MAXIMUM PRINCIPLE FOR VISCOUS FLUIDS FLOWING THROUGH REGIONS OF PURE FLUID AND MIXTURES
R. M. S. daGama and R. Sampaio 1985 6 p In PORTUGUESE; ENGLISH summary
(DE86-780543; LCC-018/85) Avail: NTIS (US Sales Only) HC A02/MF A01

A variational formulation for the problem of the flow of an incompressible Newtonian fluid through two, or more, regions is presented. Some of these regions are occupied only by the fluid and others by a saturated mixture of the fluid with a homogeneous rigid porous medium. The boundary between a region of pure fluid and another of mixture is formed by an impermeable interface that allows exchange of momentum but not of mass. The maximum of the functional is the solution of the problem. DOE

N87-21278# Dayton Univ., Ohio. Research Inst.
MULTICOMPONENT FLOW COMPRESSOR: A NEW CONCEPT FOR EFFICIENT ENERGY CONVERSION Final Report, 10 Jun. 1985 - 9 Jun. 1986
J. E. Minardi, H. P. vonOhain, M. O. Lawson, R. K. Newman, and F. L. Wattendorf Dec. 1986 82 p
(Contract DE-FG01-85CE-90234)
(DE87-004011; DOE/CE-90234/T1; UDR-TR-86-139) Avail: NTIS HC A05/MF A01

The research is based on an innovative concept of tailoring a multicomponent flow by controlled injection of uniform-size, several-micron-diameter particles in a gas flow, such as air or helium for admission to a compressor rotor, to obtain greatly improved compressor performance characteristics: three such major improvements are lowest work of compression (essentially isothermal), low rotor tip speeds, and very high compressor pressure ratios in a single stage. The objectives of the first phase were to demonstrate the effects of tailoring the multicomponent flow on the compressor pressure rise and to provide the conceptual design of the major elements of the multicomponent flow compressor system. A high specific speed rotor with 40 blades was designed and built. The rotor was housed in a vaneless diffuser and scroll designed to diffuse the particle laden gas. Preliminary data obtained with the compressor rig shows a 40% increase in pressure using particles when compared to the air only values. However, theory indicates that substantial gains in performance are still possible. Modifications to the compressor rig are presented and will be used to obtain additional data at higher particle loadings. DOE

N87-21279# Lawrence Livermore National Lab., Calif.
ON THE ARTIFICIAL VISCOSITY IN 1D SPHERICAL GEOMETRY
W. P. Crowley Jan. 1987 22 p
(Contract W-7405-eng-48)
(DE87-004449; UCID-20957) Avail: NTIS HC A02/MF A01

An artificial viscosity formulation based on the conservation equations for viscous compressible hydrodynamics is considered. The method uses tensor analysis to properly transform Richtmyer and von Neumann's artificial viscosity to non-planar geometries. It will be shown that the naive replacement of p by p+q in the Cartesian equations leads to poor results when these equations

are used in spherical geometries. In section 2 the viscous equations of motion for 1D spherical geometry are discussed. In section 3 the difference equations for momentum and energy are derived. In sections 4 and 5 the two viscosity coefficients, mu and lambda, are discussed. Section 6 describes computational results. Appendix A contains the tensor formulation and Appendix B shows the equations for cylindrical geometry. DOE

N87-21280# Sandia National Labs., Albuquerque, N. Mex.
NUMERICAL SIMULATION OF BUOYANT CONVECTION IN VENTED ENCLOSURES
J. A. Schutt and M. R. Baer 1987 9 p Presented at the 2nd ASME/JSME Thermal Engineering Conference, Honolulu, Hawaii, 22 Mar. 1987
(Contract DE-AC04-76DP-00789)
(DE86-012941; SAND-86-0790C; CONF-870304-3) Avail: NTIS HC A02/MF A01

The buoyant convection in a two-dimensional enclosure with openings is solved using a primitive variable explicit finite difference technique. A non-Boussinesq acoustically-filtered formulation is used which models inviscid buoyantly driven flows in a stratified environment. The numerical algorithm uses the flux-corrected transport (FCT) technique to resolve energy and vorticity fields, and the pressure field is determined using a direct method for solving nonseparable elliptic equations. The numerical algorithm requires that pressure and kinetic energy be combined into a dynamic pressure field. A novel method is presented for treating inflow/outflow boundaries, where the direction of flow across the boundary is not known a priori. Demonstrative calculations are shown which simulate a fire environment in a vented room of planar geometry. The fire source is idealized as a distributed energy source. The calculations show the effect of venting on entrainment and induced flow. DOE

N87-21281# Lawrence Livermore National Lab., Calif.
SHOCK WAVE INTERACTION WITH TURBULENCE: PSEUDO-SPECTRAL SIMULATIONS
A. C. Buckingham 30 Dec. 1986 9 p Presented at the Nuclear Explosives Code Development Conference, Albuquerque, N. Mex., 17 Nov. 1986
(Contract W-7405-eng-48)
(DE87-004357; UCRL-95866; CONF-8611115-3) Avail: NTIS HC A02/MF A01

Shock waves amplify pre-existing turbulence. Shock tube and shock wave boundary layer interaction experiments provide qualitative confirmation. However, shock pressure, temperature, and rapid transit complicate direct measurement. Computational simulations supplement the experimental data base and help isolate the mechanisms responsible. Simulations and experiments, particularly under reflected shock wave conditions, significantly influence material mixing. In these pseudospectral Navier-Stokes simulations the shock wave is treated as either a moving (tracked or fitted) domain boundary. The simulations assist development of code mix models. Shock Mach number and pre-existing turbulence intensity initially emerge as key parameters. DOE

N87-21282# Oak Ridge National Lab., Tenn.
VISCOSITY BEHAVIOR IN SUPERCOOLED PURE LIQUIDS AND MIXTURES
J. A. Hughes and C. H. Byers Dec. 1986 55 p
(DE87-004036; ORNL/TM-9998) Avail: NTIS HC A04/MF A01

Under relatively quiescent conditions, it is often possible to maintain fluids in a liquid state at temperatures below their freezing point. Viscosities of phenol and t-butanol in the freezing-point region deviate significantly from the Andrade correlation. Two Andrade curves, one above and one below the freezing point, cross at approximately the freezing point and fit the data well. An Antoine-type relationship fits all the phenol data well, but two such curves are required to fit the t-butanol data. The activation energy term in the Andrade equation increases significantly when the temperature drops below the freezing point. This may be interpreted as being the result of luster formation in the liquid, or at least the establishment of more short-range order in the supercooled fluid. Mixtures containing up to 1 mol % ethanol in t-butanol behaved, from a viscosity viewpoint, in a manner similar to pure t-butanol, that is, the viscosity relationship changed at the freezing point of the pure fluid and not at the freezing point of the mixture. The time dependence of the supercooled viscosity of the pure fluids was explored. DOE

N87-21283# Lawrence Livermore National Lab., Calif.
A LASER DOPPLER METHOD FOR NONINVASIVE MEASUREMENT OF FLOW VELOCITY
G. L. Biggs 25 Nov. 1986 14 p
(Contract W-7405-eng-48)
(DE87-005197; UCRL-53774) Avail: NTIS HC A02/MF A01

Laser Doppler velocimetry is a powerful optical technique for noninvasively obtaining experimental flow-velocity data. This paper describes the principle of operation and various optical configurations of the laser Doppler velocimeter. As a sample application, we describe an experimental apparatus for measuring the velocity flow field around a cylinder, and give our experimental results. DOE

N87-21284# Lawrence Livermore National Lab., Calif.
DEVELOPMENT OF A TWO-EQUATION TURBULENT MIX MODEL
C. E. Leith Dec. 1986 21 p Presented at the Nuclear Explosives Code Developers Conference, Albuquerque, N. Mex., 16 Nov. 1986
(Contract W-7405-eng-48)
(DE87-005837; UCRL-96036; CONF-8611116-4) Avail: NTIS HC A02/MF A01

Two-equation models have been widely used for estimating turbulence effects in incompressible shear flows. Here one is embedded in a one-dimensional compressible hydrodynamics code for simulation of Rayleigh-Taylor and Richtmyer-Meshkov instability induced mixing. The two equations are for turbulent kinetic energy k and its dissipation epsilon. Dimensionally correct combinations of k and epsilon give eddy diffusion coefficients which determine material mixing. The 10 model constants are chosen to match key experiments including those at AWRE on mixing at an accelerated interface. The model shows strong enhancement of turbulence by a shock in qualitative agreement with observations. DOE

N87-21285# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
MIXING IN A DOUBLE-DIFFUSIVE, PARTIALLY STRATIFIED FLUID
D. Munoz and F. Zangrando Dec. 1986 133 p
(Contract DE-AC02-83CH-10093)
(DE87-001131; SERI/TR-252-2942) Avail: NTIS HC A07/MF A01

The objective of this work was to identify the mixing mechanisms and to characterize the entrainment at the interface between a double-diffusive stratification and a mixed layer in the presence of bottom heating, cross flow or both. Because the scaling and interaction of the entrainment mechanisms were unknown, it was necessary to do the tests at a scale near that of practical engineering applications, thus involving very large Rayleigh number turbulent convection and complex flows produced by submerged turbulent jets in an enclosure. Various values of flow rate, bottom heat flux, density gradient, and mixed layer height were tested. Results of bottom heating alone and cross flow alone reproduce previously obtained results if diffusion is considered. Diffusion tends to stabilize the system when entrainment rates are on the same order of magnitude as diffusion rates. The data consistently indicated a tendency to an asymptotic value of Ri. Despite great complexity in the flow patterns observed, a generalized entrainment correlation was identified that collapses all data obtained with stratification. Results scaled by this correlation show that a simple Ri power law does not fully represent the system if diffusion is not considered, although the correlation has useful engineering applications. GRA

N87-21286# New York Univ., New York. Courant Mathematics and Computing Lab.
ADAPTIVE FINITE DIFFERENCE METHODS IN FLUID DYNAMICS
M. J. Berger Feb. 1987 53 p
(Contract DE-AC02-76ER-03077)
(DE87-004890; DOE/ER-03077/277) Avail: NTIS MF A01

Adaptive methods for solving partial differential related to fluid mechanics are surveyed. In particular the adaptive mesh refinement is discussed. This technique requires internal boundary conditions that must be conservative, data structures for keeping track of several layers of fine grid patches, error estimation, and heuristics for automatic grid generation. 3000 lines of FORTRAN code are used in this program. The inner loops vectorize and dominate the total execution time (90 Megaflops on the Cray XMP). DOE

N87-21287# Rensselaer Polytechnic Inst., Troy, N.Y.
AN INVESTIGATION OF THE CLOSURE CONDITIONS FOR TWO-FLUID MODELS OF TWO-PHASE FLOW Progress Report, 1 Apr. 1986 - 31 Mar. 1987
R. T. Lahey, Jr. and D. A. Drew Jan. 1987 62 p
(Contract DE-FG02-86ER-13489)
(DE87-004792; DOE/ER-13489/1) Avail: NTIS HC A04/MF A01

The purpose of this research is to develop methodology which can be used to assess various two-phase flow closure laws. Two-phase entropy conservation equations are derived and verified using a three-dimensional cell model. Derivation of the cell models hydrodynamic constitutive equations is included. DOE

N87-21288# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Inst. of Fluid Mechanics.
[ACTIVITIES REPORT IN FLUID MECHANICS] Annual Report, 1985
Oct. 1986 14 p Original contains color illustrations
(ETN-87-99370) Avail: NTIS HC A02/MF A01

The research conducted at the Lille Institute of Fluid Mechanics (IMFL) concerns four areas: flight mechanics, structural mechanics, aerodynamics and applied fluid mechanics. Within these four areas, these topics are discussed: characterization of the unsteady pressures on an airfoil in turbulence; adaptation of the Kalman-Rauch filtering-smoothing method to instrumented free spin tests; vulnerability of aircraft fuel tanks; water surface impact; influence of an oscillating spoiler on the surrounding aerodynamic field; gunfiring similarity theory and rules; flow around a cylinder at low Reynolds number by holographic velocimetry and laser Doppler velocimetry; compressible turbulent flow computation; and the wake of wind turbine towers are discussed. ESA

N87-21289# Rouen Univ. (France). Lab. de Thermodynamique.
NUMERICAL SIMULATION OF TURBULENT REACTIVE FLOWS Final Report [SIMULATION NUMERIQUE D'ECOULEMENTS TURBULENTS REACTIFS]
Alain Picart, Roland Borghi, and Jean-Pierre Chollet (Institut de Mecanique de Grenoble, France) Jul. 1986 26 p In FRENCH
(Contract DRET-84-173)
(ETN-87-99398) Avail: NTIS HC A03/MF A01

A direct simulation of an isotropic homogeneous turbulence is used to study the combustion of a premixed gas. The computation leads to results depending on chemical constants as shown by the different forms of probability density obtained. The representation of the reactive front is accomplished using the finite volume method. The classical Eulerian computation is found satisfactory while the trials to quantify in the proximity of the interface are disappointing. ESA

N87-21290# Institut National des Sciences Appliquees, Lyon (France).
MODELING THE CONVECTION-RADIATION COUPLING IN POROUS MATERIALS AND IDENTIFICATION OF THEIR RADIATION CHARACTERISTICS: APPLICATION TO GLASS WOOLS Ph.D. Thesis [MODELISATION DU TRANSFERT COUPLE RAYONNEMENT-CONVECTION AU SEIN DE MATERIAUX POREUX ET IDENTIFICATION DE LEURS PROPRIETES RADIATIVES. APPLICATION AUX LAINES DE VERRES]
Genevieve Uny 1986 131 p In FRENCH Sponsored by the Agence Francaise pour la Maitrise de l'Energie, and the Programme Interdisciplinaire de Recherches sur les Sciences pour l'Energie et les Matieres Premieres
(INSA-86-ISAL-0007; ETN-87-99408) Avail: NTIS HC A07/MF A01

A coupled convection-radiation heat transfer model is developed. The case of a rectangular cavity filled with porous materials having two isothermal walls and two adiabatic walls is considered. The radiation is studied assuming a two flow finite difference model. The determination of the radiation parameters of semitransparent bodies is also studied, based on the two directional spectral transmittance. The results obtained using pure silica fibers are presented. The role played by radiation is highlighted, showing its contribution of 25% heat loss for low temperature heat insulators and 55% for the case of high temperature insulators. ESA

N87-21291# Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides.
MODELING THE INTERACTIONS SHOCK WAVE/TURBULENT BOUNDARY LAYER. COMPARISON OF MODEL WITH EXPERIMENT Ph.D. Thesis [MODELISATION DE L'INTERACTION ONDE DE CHOC / COUCHE LIMITE TURBULENTE. COMPARISON CALCUL-EXPERIENCE]
Beatrice Escande 1986 169 p In FRENCH
(ECL-86-16; ETN-87-99422) Avail: NTIS HC A08/MF A01

The results obtained using a direct solution of Navier-Stokes equation method are presented. One algebric model is based on a mixed length hypothesis, another uses two transport equations. The studied configuration is the transonic two dimensional symmetric channel flow which leads to several interactions between the shock wave and the separated boundary layer. The results indicate the advantages of using more sophisticated models to describe turbulence phenomena. ESA

N87-21292# Royal Netherlands Meteorological Inst., De Bilt.
NUMERICAL BOUNDARY CONDITIONS WITH MINIMAL REFLECTION FOR LIMITED-AREA MODELS [NUMERIEKE RANDVOORWAARDEN MET MINIMALE REFLECTIE VOOR MODELLEN OP EEN EINDIG DOMEIN]
J. I. vandenBerg 1986 95 p In DUTCH
(KNMI-WR-86-3; B8677235; ISSN-0169-1651; ETN-87-99262)
Avail: NTIS HC A05/MF A01

The possible boundary conditions for minimal disturbances which can be imposed in order to make a set of differential equations describing the boundary layer soluble are studied. This set is underdetermined when solved discretely. The consequences for the possible solutions of the discrete approximations of a differential equation are tested. It is shown that the discrete approximation of the advection equation with central differences gives rise to two possible wave equations: the first approximates the analytic solution, the second is the so-called computational mode. Several boundary conditions were tested for the one-dimensional linear advection equation. The condition of Sundstrom and Elvius is the most suited because of its simplicity. The boundary conditions necessary for the numerical solution of a linearized two-dimensional hydrostatic Boussinesq set of equations on a limited domain were examined. The leap-frog time discretization scheme and a central difference for the space derivative are shown to be suited. ESA

N87-21293# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorbauelemente.
USE OF LASER-DOPPLER-ANEMOMETRY FOR THE MEASUREMENT OF VELOCITY DISTRIBUTIONS AT THE INTAKE OF A LONGITUDINAL FLOW HEAT EXCHANGER
W. Cronenbroeck Jul. 1986 48 p In GERMAN; ENGLISH summary
(Juel-Spez-362; ISSN-0343-7639; ETN-87-99337) Avail: NTIS HC A03/MF A01

Laser-Doppler-Anemometry (LDA) was used to measure flow velocities between 1mm/sec and supersonic speed. The princi-

ples as well as the LDA-system components are described. Signal-processing and the special conditions of use are discussed. The measurement of a two-dimensional velocity distribution at the intake of a longitudinal flow heat exchanger is shown. ESA

N87-21294# Metraflu, Ecully (France).
THEORETICAL AND EXPERIMENTAL SYNTHESIS OF TURBULENCE ESTIMATION SPECTRAL METHODS FOR AERODYNAMIC COMPUTATIONS. PART 2: MANIFESTATIONS OF THE MECHANISMS RELATED TO LARGE ORIENTED STRUCTURES IN HOMOGENEOUS TURBULENCE. PART A: EXPERIMENTAL STUDY. PART B: THEORETICAL STUDY Final Report [SYNTHESE THEORIQUE ET EXPERIMENTALE DES METHODES SPECTRALES DE PREVISION DE LA TURBULENCE UTILISABLES POUR DES CALCULS A FINALITE AERONAUTIQUE. PARTIE A: ETUDE EXPERIMENTALE; PARTIE B: ETUDE THEORIQUE]
M. Michard and J. P. Bertoglio Jul. 1986 79 p In FRENCH
(Contract DRET-84-355)
(ETN-87-99395) Avail: NTIS HC A05/MF A01

Large scale structured eddies are introduced in a network turbulence model. The turbulence generated by this network is characterized by a spectrum with a large single peak, which suggests that the spectral approach would be more efficient. The tendency (found in the experiments) to show periodic distribution of the field anisotropy is reproduced in the numerical simulations. The conditions necessary for the study of the behavior of the spectral peak are discussed. ESA

N87-21295# Metraflu, Ecully (France).
THEORETICAL AND EXPERIMENTAL SYNTHESIS OF TURBULENCE ESTIMATION SPECTRAL METHODS FOR AERODYNAMIC COMPUTATIONS. PART 3: SPECTRAL MANIFESTATIONS OF INHOMOGENEITY DUE TO FIELD EFFECTS AND TO THE PRESENCE OF WALLS Final Report [SYNTHESE THEORIQUE ET EXPERIMENTALE DES METHODES SPECTRALES DE PREVISION DE LA TURBULENCE UTILISABLES POUR DES CALCULS A FINALITE AERONAUTIQUE. MANIFESTATIONS SPECTRALES DE L'HOMOGENEITE DUE AU CHAMP PORTEUR ET A LA PRESENCE DE PAROIS]
D. Jeandel Jul. 1986 82 p In FRENCH
(Contract DRET-84-355)
(ETN-87-99396) Avail: NTIS HC A05/MF A01

Nonhomogeneous turbulent fields limited by geometrical boundaries (solid walls) are studied. A direct analysis of the behavior of a perturbation in the case of a plane channel is presented, including a linear study, (analytical and numerical) and a numerical nonlinear approach. A computer program based on spectral methods was developed in the overall nonhomogeneous turbulence study program. The direct simulation shows the effects of nonlinear factors and by choice of physical parameters it is possible to generate an evolution significantly different from linear estimations. ESA

N87-21296# Metraflu, Ecully (France).
THEORETICAL AND EXPERIMENTAL SYNTHESIS OF TURBULENCE ESTIMATION SPECTRAL METHODS FOR AERODYNAMIC COMPUTATIONS. PART 4: STUDY OF ENTRAINMENT MECHANISMS USING SIMULATIONS AND EXPERIMENTAL RESULTS Final Report [SYNTHESE THEORIQUE ET EXPERIMENTALE DES METHODES SPECTRALES DE PREVISION DE LA TURBULENCE UTILISABLES POUR DES CALCULS A FINALITE AERONAUTIQUE. ETUDE DES MECANISMES D'ENTRAINEMENT A PARTIR DE SIMULATIONS ET DE RESULTATS EXPERIMENTAUX]
F. Ladhari, R. Morel, and J. P. Bertoglio Jul. 1986 43 p In FRENCH
(Contract DRET-84-355)
(ETN-87-99397) Avail: NTIS HC A03/MF A01

Turbulence estimation spectral methods were tested in a low velocity Eiffel type wind tunnel. Turbulence generation and visualization techniques were used. The results include average velocities, velocity fluctuations, and Reynolds stresses. The study shows the role of a deterministic structure on the essential characteristics of a sheared flow. Numerical simulations were also carried out using a pseudo-spectral code. Details of the method are given. The evolution of the velocity fields is shown. The results obtained over 16-cubed networks are insufficient for this type of study. The expansion to 32-cubed shows a much better accuracy. ESA

N87-21297# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
SOLUTION OF THE STEADY STATE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS IN CURVILINEAR NONORTHOGONAL COORDINATES
V. Michelassi and C. Benocci Aug. 1986 72 p
(VKI-TN-158; ETN-87-99449) Avail: NTIS HC A04/MF A01

An implicit Navier-Stokes solver was developed using the approximate factorization method of Beam and Warming (1978 to 1979) to solve two dimensional incompressible laminar steady internal flows using the primitive variables formulation of the Navier-Stokes equations. The Chorin (1967) artificial compressibility equation is employed to evaluate the pressure. Spherical coordinates are used to allow the numerical model to cope with the largest possible number of wall geometries. Methods for the introduction of the artificial dissipation terms needed to obtain wiggles-free results when using a centered space discretization are proposed. Formulations for a time step variable in space were tested to improve the convergence rate. Flows in channels with streamlined walls, backward facing steps, and channels with obstacles were computed. ESA

N87-21298# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
THE INFLUENCE OF THE WALL BOUNDARY CONDITION ON A SOLUTION OF THE INCOMPRESSIBLE NAVIER-STOKES EQUATION
C. Benocci and V. Michelassi Aug. 1986 46 p
(VKI-TM-42; ETN-87-99450) Avail: NTIS HC A03/MF A01

The influence of the formulation and discretization of the boundary condition for the pressure on solid walls upon the accuracy and convergence rate of the solution of the incompressible steady state Navier-Stokes equations written in the primitive variables, over a non staggered mesh, with finite differences techniques, was investigated. The boundary conditions tested include different formulations and finite difference discretizations for the derivative of the pressure in the direction normal to the wall, as well as the possibility to apply on the wall itself the artificial compressibility equation, linked with the adoption of a pseudo-staggered mesh. The results show that for Reynolds numbers considered (75,100) the choice of the boundary condition does not have a significative influence on the results. ESA

N87-21299# Technische Hogeschool, Eindhoven (Netherlands).
ELECTROKINETIC AND HYDRODYNAMIC TRANSPORT THROUGH POROUS MEDIA Ph.D. Thesis
Adrianus Josef Kuin 1986 127 p Sponsored by Stichting Technische Wetenschappen
(ETN-87-99581) Avail: NTIS HC A07/MF A01

Methods to determine particle size and shape distributions in porous media are compared. Stationary and frequency dependent transport phenomena through porous beds are described. A pore model to describe stationary transport is developed. The model combines periodic constrictions with sharp angles in the pore wall. The electroosmotic dewatering of cement mortar as a function of the particle size and applied potential is shown. ESA

N87-21300# Technische Hogeschool, Eindhoven (Netherlands).
FLOW PROPERTIES OF He3 IN DILUTE He3-He4 MIXTURES AT TEMPERATURES BETWEEN 10 AND 150 mK Ph.D. Thesis
Cornelis Adrianus Marcellus Castelijns 1986 120 p
(ETN-87-99582) Avail: NTIS HC A06/MF A01

The flow properties of He3 moving in dilute He3-He4 mixtures at temperatures between 10 and 150 mK, were studied in an He3 circulating dilution refrigerator with a flow rate ranging between

0.13 and 2.5 mmol/sec. Temperature, pressure, and He3-concentration variations across tubes were measured as functions of the flow rate and the tube sizes. Results yield a set of empirical relations for the He3 flow properties at variance with the mechanical vacuum model. The experimental results are analyzed taking into account a viscous force between the He3 quasiparticles, as well as a mutual friction force between He3 and He4. The relations taking into account both a viscous force and a mutual friction force give a good description of the He3 flow properties in dilute He3-He4 mixtures. ESA

N87-21301# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
A PREDICTION METHOD FOR THE AIR-DROPLETS FLOW IN THE INLET SECTION OF A NATURAL DRAFT COOLING TOWER
C. Benocci, J.-M. Buchlin, and P. Weinacht Jan. 1986 58 p
(VKI-TM-40; EAT-8602/CB-JMB-PW/NT; ETN-87-99841) Avail: NTIS HC A04/MF A01

A numerical model for the prediction of gas-droplet flow was improved. The solver is based on the coupled solution of the transport equations for the gas and droplet phases, in two dimensional and axisymmetric geometries, with finite difference techniques. Turbulence is modeled with a transport equation for the eddy viscosity and a modification to the basic model is introduced to take into account the effect of the droplets. The solver is applied to the prediction of air droplet flow in the inlet region of a cooling tower. Good agreement is found with small scale tests and full scale measurements. ESA

N87-21302# National Bureau of Standards, Gaithersburg, Md. Center for Fire Research.
TIME-DEPENDENT SIMULATION OF SMALL-SCALE TURBULENT MIXING AND REACTION Annual Report, Nov. 1984 - Nov. 1985
H. R. Baum, R. G. Rehm, D. M. Corley, and D. W. Lozier Feb. 1986 43 p
(Contract AFOSR-ISSA-85-0026)
(PB87-140257; NBSIR-86-3334) Avail: NTIS HC A03/MF A01 CSCL 20D

A mathematical model of the local transient diffusion-controlled reaction between initially unmixed species is presented. It is intended ultimately as a computational molecule to be imbedded in direct simulations of larger scale reacting flows. The model consists of an interacting three-dimensional strain vortex field which exactly satisfies the Navier-Stokes equation, an analytically determined Lagrangian representation of the mixing process and convection-diffusion equations for the reacting species in Lagrangian coordinates. The length scale established by the stretching of the vorticity field is shown to be directly relatable to the Kolmogoroff scale if the local strain rate has a scale consistent with laminar boundary layer mixing. An analytical solution to the convection-diffusion equation governing the diffusion-controlled reaction is derived. The solution is valid for large Schmidt number and describes the evolution of any initially two-dimensional configuration of reactants. A special two-dimensional case of this model, in which vortex strain is excluded and fuel and oxidizer initially occupy adjacent half-spaces, is also analyzed. GRA

N87-21303*# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
BOUNDARY-LAYER COMPUTATIONAL MODEL FOR PREDICTING THE FLOW AND HEAT TRANSFER IN SUDDEN EXPANSIONS
J. P. Lewis and R. H. Pletcher Jul. 1986 235 p Sponsored by NASA and NSF
(Grant NSF CBT-82-11713)
(NASA-CR-180272; NAS 1.26:180272; PB87-133252;
ISU-ERI-AMES-87018) Avail: NTIS HC A11/MF A01 CSCL 20D

Fully developed turbulent and laminar flows through symmetric planar and axisymmetric expansions with heat transfer were modeled using a finite-difference discretization of the boundary-layer equations. By using the boundary-layer equations to model separated flow in place of the Navier-Stokes equations, computational effort was reduced permitting turbulence modelling studies to be economically carried out. For laminar flow, the reattachment length was well predicted for Reynolds numbers as low as 20 and the details of the trapped eddy were well predicted for Reynolds numbers above 200. For turbulent flows, the Boussinesq assumption was used to express the Reynolds stresses in terms of a turbulent viscosity. Near-wall algebraic turbulence models based on Prandtl's-mixing-length model and the maximum Reynolds shear stress were compared. GRA

N87-21182# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.
EVALUATION OF L2F-MEASUREMENTS IN UNSTEADY TURBINE FLOW
W. Foerster, R. Schodl, and H. Kruse *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 12 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21185# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
THE FLOW AROUND A SQUARED OBSTACLE
D. F. G. Durao, M. V. Heitor, and J. C. F. Pereira *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 13 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21193# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
DIGITAL IMAGE PROCESSING APPLIED TO FLUID DYNAMIC PROBLEMS
J. M. Buchlin *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 10 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N87-21304* National Aeronautics and Space Administration. Pasadena Office, Calif.
LOW NOISE LEAD SCREW POSITIONER Patent
Gerald S. Perkins, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena) Issued 6 May 1986 6 p Filed 30 Jul. 1982 Supersedes N82-33681 (20 - 24, p 3437)
(NASA-Case-NPO-15617-1; US-Patent-4,586,394;
US-Patent-Appl-SN-403849; US-Patent-Class-74-424.8-R;
US-Patent-Class-74-89.15; US-Patent-Class-74-441;
US-Patent-Class-74-458; US-Patent-Class-74-468) Avail: US Patent and Trademark Office CSCL 14B

A very precise and low noise lead screw positioner, for positioning a retroreflector in an interferometer is described. A gas source supplies inert pressurized gas, that flows through narrow holes into the clearance space between a nut and the lead screw. The pressurized gas keeps the nut out of contact with the screw. The gas flows axially along the clearance space, into the environment. The small amount of inert gas flowing into the environment minimizes pollution. By allowing such flow into the environment, no seals are required between the end of the nut and the screw.

Official Gazette of the U.S. Patent and Trademark Office

N87-21305 National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.
REPORT ON THE CALIBRATION OF TWO SPINNING-ROTOR GAUGES FOR THE BIPM VERY LOW PRESSURE INTERCOMPARISON
F. Redgrave and P. J. Nash Jan. 1987 27 p
(NPL-MOM-80; ISSN-0309-3067; ETN-87-99808) Copyright. Avail: Issuing Activity

Calibrations were carried out as part of an intercomparison of very low pressure standards. The transfer standards supplied consisted of two spinning-rotor gage balls and fingers. The intercomparison was performed using argon as the test gas. Additional calibrations were carried out using hydrogen. ESA

N87-21306# Royal Aircraft Establishment, Farnborough (England).
INSPECTION OF COMPLEX PROFILES: A REVIEW OF THE METHODS AVAILABLE, AND BEST SUITED TO THE NEEDS OF RAE PYESTOCK
I. Sudlow Jan. 1986 71 p
(RAE-TM-P-1077; BR99614; ETN-87-99471) Avail: NTIS HC A04/MF A01

Profile inspection methods are reviewed and coordinate measuring machines are described. The use of a vector drive system, retrofitted to the existing coordinate measuring machine is recommended in addition to further investigations into an AutoMATE, moire fringe based, profile measuring system. ESA

N87-21307*# National Aeronautics and Space Administration, Washington, D.C.
AUTOMATIC PROCESSING SYSTEM FOR SHADOWGRAPH AND INTERFERENCE PATTERNS
I. A. Vereninov, V. D. Lazarev, S. S. Popov, and V. S. Tarasov Feb. 1987 10 p Transl. into ENGLISH from the mono. "Sistema Avtomatizirovannogo Obmera Tenevykh i Interferentsionnykh Kartin" Leningrad, USSR, Nauka, 1979 p 221-226 Original language document was announced in IAA as A81-24516 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88525; NAS 1.15:88525) Avail: NTIS HC A02/MF A01 CSCL 14B

The design and operation of an automatic system for the processing of shadowgraph and interference images are described. The system includes a two-coordinate processing table with an optical system for the projection of transparent images onto the photodetector, an image filter in the photodetector field, and a device for controlling the movement of the table and transmitting information to the minicomputer. Author

N87-21308# Sandia National Labs., Albuquerque, N. Mex.
APPLICATION OF A HIGH-PRECISION UNIVERSAL MEASURING MACHINE IN STANDARDS LABORATORY MEASUREMENTS
D. W. Braudaway 1987 6 p Presented at the IEEE IMTC Conference on the Changing Face of I and M Technologies, Boston, Mass., 27 Mar. 1987
(Contract DE-AC04-76DP-00789)
(DE87-003036; SAND-86-1698C; CONF-870370-1) Avail: NTIS HC A02/MF A01

A computer controlled high-precision Universal Measuring Machine (UMM) of advanced design has been placed in operation. Full high-accuracy operation of the machine awaits development of techniques to map and correct the machine's three-dimensional measuring space. In the meantime, the UMM is being applied to the calibration of high-precision artifacts in single- and limited two-dimensional space, aided by checks against length master reference standards. These artifacts, principally step-gages and roundness standards, require ratio type techniques similar to those employed in calibration of electrical ratio devices. The application is yielding significant time savings and accuracy enhancement. Analytical power of the machine's computer system simplifies data collection, improves computation of results, and permits deterministic checks where judgmental checks have been the practice. DOE

N87-21309# Institut de Mecanique des Fluides de Lille (France).
STUDY OF VARIOUS HOLOGRAPHIC ASSEMBLIES TO OBSERVE PARTICLES SMALLER THAN DIFFRACTION LENGTH, IN FLOWS WITH OR WITHOUT DENSITY GRADIENTS [ETUDE DE DIFFERENTS MONTAGES HOLOGRAPHIQUES POUR L'OBSERVATION DE PARTICULES PLUS PETITES QUE LA TAILLE DE DIFFRACTION, DANS DES ECOULEMENTS AVEC OU SANS GRADIENT DE MASSE VOLUMIQUE]
Michel Stanislas 23 Sep. 1986 40 p In FRENCH
(Contract DRET-84-34-003)
(IMFL-86/21; ETN-87-99393) Avail: NTIS HC A03/MF A01

Optical assemblies were investigated in order to improve the Gabor holographic method. The use of smaller particles could considerably increase turbulence measurement accuracy. Among the assemblies with a separate reference only one is sufficiently accurate. The object faces the hologram and the reference is a parallel light beam at 45 deg to the hologram. Another assembly derived from Gabor method has the required characteristics. Its main limitation is the reduction of the observation field. ESA

N87-21310# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.
A DRIFT CHAMBER WITH VARIABLE DRIFT VELOCITY
F. Hartjes, J. Timmermans, F. Udo, and N. Zonjee Jun. 1986 29 p Submitted for publication
(NIKHEF-H/86-12; B8675155; ETN-87-99596) Avail: NTIS HC A03/MF A01

A wedge type drift chamber to be used as part of the inner detector of the DELPHI high energy particle collision experiment is described. The chamber features drift velocities (carefully controlled) proportional to the total drift distance to facilitate triggering. The gas choice and its consequences for calibration with and without magnetic field are discussed. Long-term stability and the effect of a magnetic field were measured with a prototype drift chamber. Most tests were done with a laser beam with single wire accuracies below 20 micron. ESA

N87-21187# Land Turbine Sensors, Inc., Tullytown, Pa.
SOME CONSIDERATIONS RELATING TO AERO ENGINE PYROMETRY
P. J. Kirby *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 14 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21188# Technische Hochschule, Aachen (West Germany). Inst. for Jet Propulsion and Turbomachinery.
TURBINE ROTOR BLADE MEASUREMENTS USING INFRARED PYROMETRY
W. Koschel, D. Salden, and T. Hoch *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 16 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21194# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
PROCESSING TECHNIQUES FOR CORRELATION OF LDA AND THERMOCOUPLE SIGNALS
M. N. R. Nina and G. P. A. Pita *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 8 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21202# Warwick Univ. Coventry (England). Dept. of Engineering.
THE APPLICATION OF HOLOGRAPHY AS A TRANSONIC FLOW DIAGNOSTIC TO ROTATING COMPONENTS IN TURBOMACHINERY
P. J. Bryanston-Cross *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 22 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N87-21311 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
THE IMPROVEMENT AND EVALUATION OF A LASER INTERFEROMETER FOR THE ABSOLUTE MEASUREMENT OF ULTRASONIC DISPLACEMENTS IN THE FREQUENCY RANGE UP TO 15 MHz
D. R. Bacon Nov. 1986 80 p Submitted for publication
(NPL-AC-109; ISSN-0143-7143; ETN-87-99807) Copyright. Avail: Issuing Activity

A laser interferometer was applied to the absolute calibration of hydrophones in the frequency range 0.5 to 15 MHz. The optimum experimental arrangement and method of calibration were defined and corrections for effects which influence the measurement were studied. The reproducibility of the method is 1% and the estimated systematic uncertainty ranges from 2.1% at 0.5 MHz to 6.3% at 15 MHz. A hydrophone was calibrated using the interferometer and using two other methods, and the results are in agreement to within the estimated uncertainties. ESA

N87-21312# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
PERFORMANCE OF TWO COUPLED LASERS
Harold Mirels 5 Feb. 1987 49 p
(Contract F04701-85-C-0086)
(AD-A177185; TR-0086(6907)-1; SD-TR-86-96) Avail: NTIS HC A03/MF A01 CSCL 20/5

The theory of Spencer and Lamb for the performance of two coupled lasers is generalized to account for intercavity phase shifts (transmitted wave minus reflected wave) other than + or pi/2. The results are directly applicable for the case of two coupled single line Fabry Perot resonators with intercavity losses. Analytic expressions are given for steady state performance and for the regions stable operation. It is concluded that it is generally not possible to achieve stable operation on all potential laser lines for two multiline couple lasers. Competition between stable and unstable lasing modes, in these devices, may result in stable operations on a reduced number of lines. Author

N87-21313# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
LASER EVAPORATION STUDIES Annual Report, 1 Sep. 1985 - 30 Aug. 1986
H. Sankur Oct. 1986 32 p
(Contract F49620-84-C-0091)
(AD-A176826; SC5411.AR; AFOSR-87-0158TR; AR-2) Avail: NTIS HC A03/MF A01 CSCL 13/8

The use of a pulsed laser to evaporate dielectric materials for optical thin film deposition was investigated. The electrical properties of the laser induced plasma in the evaporant plume were studied. High flux (20A/sq cm) of high velocity (1 to 10 million) cm/s) ionic species were observed in the TEA-CO2 laser evaporation of many refractory oxides, chalcogenides and fluorides. Thin films of ZrO2 were deposited out of a plasma described above. These films were dense, oriented polycrystalline and had bulk refractive index values (2,15), low absorption (K about 0.001) and low particulate density for a range of laser fluence values. In the next and final phase of this project, thin film studies will be extended to a wider array of materials, with emphasis on obtaining high quality films with low particulate densities. GRA

N87-21314# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
SATURATION EFFECTS IN COUPLED LASERS WITH HOMOGENEOUS GAIN
Harold Mirels 30 Sep. 1986 31 p
(Contract F04701-85-C-0086)
(AD-A176843; TR-0086(6060)-3; SD-TR-86-94) Avail: NTIS HC A03/MF A01 CSCL 20/5

The effects of saturation on the performance of coupled lasers with homogeneous gain are evaluated. Analytic steady state results are obtained for cases where the intensity is the same in each laser. Output power is at a maximum when both lasers have the same mirror separation and a distance between them that corresponds to an integral number of wavelengths. If these conditions are changed, the result is reduced stability in addition to lower output power. A previous model, which employed third order saturation, underpredicts the increase in output power with an increase in saturation but is qualitatively correct with regard to regimes for stable operation. GRA

N87-21315# Physical Sciences, Inc., Andover, Mass.
EXPERIMENTAL AND THEORETICAL STUDIES OF LASER PROPULSION PHENOMENOLOGY Final Technical Report, Apr. 1985 - May 1986
D. Rosen, N. Kemp, R. Krech, J. Campbell, and G. Caledonia 18 Dec. 1986 74 p
(Contract F49620-85-C-0072)
(AD-A176851; PSI-034/TR-579; AFOSR-87-0125TR) Avail: NTIS HC A04/MF A01 CSCL 21/8

This report describes a research effort carried out to provide data crucial to the ultimate development of both CW and pulsed laser propulsion technologies. The CW effort involved extending our examination of absorption of 10 and 3 micrometer laser radiation by molecules at elevated temperatures. Test gases were heated to temperatures of 1000 to 4500 K via shock excitation. Both absorption coefficients and saturation intensity levels were evaluated. Until these recent efforts, such a high temperature data base was virtually non-existent and further, with the exception of diatomics, not readily amenable to theoretical extrapolation. These measurements are essential in evaluating CW laser thruster performance and, as fallout, could also provide a useful testbed for future theoretical predictions of molecular structure. Pulsed laser propulsion utilizes laser induced breakdown to develop a high temperature plasma which can subsequently be expanded to provide thrust. The three principal stages of the operation of such a thruster are: (1) laser-induced breakdown, (2) subsequent laser energy absorption in the laser-produced plasma, and (3) non-steady expansion of this hot, high pressure gas down a nozzle to produce thrust. GRA

N87-21316# Laser Applications Research Center, The Woodlands, Tex.
SHORT WAVELENGTH LASER/MATERIALS INTERACTIONS Annual Technical Report, 1 Sep. 1985 - 31 Oct. 1986
Michael J. Berry 30 Nov. 1986 37 p
(Grant AF-AFOSR-0365-85)
(AD-A176950; LARC-TR-86-001; AFOSR-87-0089TR) Avail: NTIS HC A03/MF A01 CSCL 20/5

This report summarizes work completed on Short Wavelength Laser/Materials Interactions. The following projects have been completed: (1) microscale laser/materials experiments using CW chemical and rp excimer laser irradiation sources; (2) studies of short wavelength interaction phenomenology and effects; (3) development and use of laser probe attenuation and absorption systems for measurements on laser ablated plumes; (4) quadrupole mass spectrometric studies of laser pyrolysis products; and (5) laser hardened materials evaluations. GRA

N87-21317# Lawrence Livermore National Lab., Calif. Mechanical Engineering Dept.
PRECISION CUTTING AND DRILLING WITH THE Nd-YAG LASER
A. C. Lingenfelter, C. D. Anglin, C. N. Westrich, and J. R. Murchie Oct. 1986 10 p Presented at ICALEO '86: Laser Application Conference, Arlington, Va., 10 Nov. 1986
(Contract W-7405-eng-48)
(DE87-001359; UCRL-95516; CONF-861197-1) Avail: NTIS HC A02/MF A01

The capability of focusing large amounts of energy onto a very small area makes the laser a useful tool for cutting and drilling materials. With the aid of appropriate aperture, lens, and

careful selection of laser parameters, we have been successful in cutting slots 0.001 inches (0.025 millimeters) in width and drilling holes 0.00015 inches (0.0038 millimters) in diameter. Examples of these applications are shown. Cutting and drilling of foil thicknesses (less than 0.010 inches thick) poses a special problem. Despite careful selection of operating parameters there is normally some small amount of dross adhering to the bottom surface of the foil. We have found that various surface coatings can be used to protect the foil from damage both during processing and cleanup. Several examples illustrate the surface quality of cuts achieved with coated foils. DOE

N87-21318# Sandia National Labs., Albuquerque, N. Mex.
PHASE SELECTION DURING PULSED LASER ANNEALING OF Fe-V ALLOYS
J. H. Perepezko, D. M. Follstaedt, and P. S. Peercy 1986 7 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986 Prepared in cooperation with Wisconsin Univ., Madison
(Contract DE-AC04-76DP-00789)
(DE87-003507; SAND-86-1343C; CONF-861207-36) Avail: NTIS HC A02/MF A01

Pulsed laser melting of the low-temperature sigma (tetragonal, D8 sub b) phase has been used to generate a liquid undercooled with respect to the melting point of the higher temperature, equilibrium alpha (bcc) solid solution in equiatomic Fe-V alloys. From calculations based on reported thermodynamic data and equilibrium transformation temperatures, the metastable melting point of the sigma phase is about 1720 K for an Fe-50 at.% V alloy, 54 K below the melting temperature of the alpha phase. During rapid heating of well-annealed sigma-phase material with a 30 ns laser pulse to above melt threshold the sigma + alpha reaction is suppressed, so that the melt zone is undercooled by approx 54 K with respect to the equilibrium alpha phase. The alpha phase nucleates from the undercooled molten surface layer and is retained during the subsequent rapid cooling (approx. 10 to the 10th power K/s) because of the relatively alpha + sigma transformation. X-ray diffraction and TEM identified the alpha phase in the near-surface after melting sigma with incident laser energies (1.0 to 1.41 J/sq cm) which are well above the melt threshold as determined by changes in reflectivity (approx. 0.7 J/sq cm). DOE

N87-21319# Rochester Univ., N. Y. Inst. of Optics.
NONLINEAR OPTICS WITH BROAD-BAND LASERS Progress Report, 15 Jul. 1986 - Jul. 1987
M. G. Raymer Jan. 1987 22 p
(Contract DE-AC02-81ER-10979)
(DE87-004306; DOE/ER-10979/13) Avail: NTIS HC A02/MF A01

During this period a number of significant results were obtained and new investigations established. The studies of the fluctuation dynamics of pulsed dye lasers and of stimulated Raman scattering (SRS) were completed. The main results obtained in this work are: (1) mode intensities and phases were found to be correlated in a pulsed dye laser; (2) conditions were found under which the dye laser produced FM-locked output; (3) a method was found for smoothing the temporal shape of the dye laser pulses; (4) Stokes intensity autocorrelation and laser-Stokes cross-correlation measurements showed that the development of correlations between the pump laser light and Stokes light generated by SRS depends on the relationship between two time scales - that of the laser fluctuations and that of the molecular Raman response. A new multifaceted program has been established to study the statistical aspects of broadband continuous-wave dye lasers that are relevant to better understanding intracavity laser spectroscopy (ILS). The central, still unanswered, question in this field is: what mechanisms limit the mode lifetimes and thereby limit the present and ultimately achievable sensitivity of ILS. The goal is to eliminate all extrinsic mechanisms, leaving only those intrinsic to the laser-quantum noise and deterministic chaos. DOE

N87-21320# Lawrence Livermore National Lab., Calif.
LASER MICROFABRICATION TECHNOLOGY AND ITS APPLICATION TO HIGH SPEED INTERCONNECT OF GATE ARRAYS
A. F. Bernhardt, B. M. McWilliams, F. Mitlitsky, and J. C. Whitehead Dec. 1986 18 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986
(Contract W-7405-eng-48)
(DE87-004363; UCRL-95040; CONF-861207-32) Avail: NTIS HC A02/MF A01

A goal of the LLNL Laser Pantography (LP) program has been demonstrating processes in which a computer-steered and computer-modulated laser beam directly deposits or removes material onto or from a substrate such as a silicon wafer. Substantial advantages could accrue from a fully developed set of such processes, including: lower cost for prototyping and low volume manufacturing, faster fabrication, on-line repair, and customized computers. DOE

N87-21321# Auburn Univ., Ala. Dept. of Chemical Engineering.
LASER LIGHT-SCATTERING AND LASER FLUORESCENCE STUDIES OF SOLVENT EXTRACTION SYSTEMS
R. D. Neuman 1986 8 p Presented at the International Solvent Extraction Conference, Munich, West Germany, 11 Sep. 1986
(Contract DE-FG05-85ER-13357)
(DE87-003910; DOE/ER-13357/5; CONF-860921-7) Avail: NTIS HC A02/MF A01

The solvent extraction of metal ions from an aqueous solution to a nonpolar organic phase is a separation operation of major technological significance in the hydrometallurgical and nuclear industries. It is now recognized that the interface plays a key role in the extraction process. However, the interfacial chemistry which occurs in the solvent extraction of metal ions is still very incompletely understood. Although investigations of the interfacial behavior of extraction reagents, in the past, have provided valuable information, progress is becoming more difficult in obtaining new fundamental information from classical surface-chemical approaches. The application of more sophisticated and recently developed techniques, such as laser techniques, holds promise for significant advances in understanding the molecular principles underlying the interfacial behavior of extractant molecules and their interactions with metal ions. This paper will discuss recent advances in laser light-scattering and laser fluorescence techniques and their application to liquid/liquid interfacial systems. DOE

N87-21322# Los Alamos National Lab., N. Mex.
A SELF-SIMILAR APPROACH TO THE EXPLOSION OF DROPLETS BY A HIGH ENERGY LASER BEAM
S. M. Chitanvis 30 Dec. 1986 4 p Presented at the OSA/APS International Laser Science Conference, Seattle, Wash., 20 Oct. 1986
(Contract W-7405-eng-36)
(DE87-005124; LA-UR-87-22; CONF-861038-5) Avail: NTIS HC A02/MF A01

A model has been constructed in which a small droplet is exploded by the absorption of energy from a high energy laser beam. The beam flux is so high that it is assumed that a plasma is formed. A single-fluid model of a plasma droplet interacting with laser radiation is used. Selfsimilarity is invoked to reduce the spherically symmetric problem involving hydrodynamics and Maxwell's equations to quadrature. It is shown analytically that the model reproduces in qualitative manner certain features observed experimentally. DOE

N87-21323# Sandia National Labs., Albuquerque, N. Mex.
A 1-ms ELECTRON BEAM FACILITY FOR LASER KINETIC STUDIES
G. E. Samlin and E. L. Patterson 1986 9 p Presented at the 9th International Conference on Lasers and Applications, Orlando, Fla., 3 Nov. 1986
(Contract DE-AC04-76DP-00789)
(DE87-003299; SAND-86-1278C; CONF-861177-2) Avail: NTIS HC A02/MF A01

The design of a facility to investigate laser kinetics with a

1-ms long e-beam pulse is described. An electrostatic accelerator coupled with a lambda geometry laser cell will permit excimer laser studies at low excitation rates. DOE

N87-21324# Rochester Univ., N. Y. Lab. for Laser Energetics.
LLE REVIEW Quarterly Report, Jan. - Mar. 1986
A. Schmid, ed. 1986 64 p Prepared in cooperation with Empire State Electric Energy Research Corp., N.Y., General Electric Co., N.Y., N.Y. State Energy Research and Development Authority, Hydro-Electric Power Commission, Toronto, Ontario, Southern Calif. Edison Co., and DOE
(Contract DE-FC08-85DP-40200)
(DE87-005865; DOE/DP-40200/24-Vol-26) Avail: NTIS HC A04/MF A01

This volume of the LLE Review contains reports on OMEGA and GDL laser activities; characterization of laser-generated X-ray sources for nuclear level excitation; the physics of parametric instabilities driven by two pump beams in laser-produced plasmas; developments in advanced technology areas at LLE, specifically ultra-high-speed opto-electronic devices and methods and the modeling of thin-film features in physical vapor deposition; and the National Laser Users Facility activities from January to March 1986. The following are highlights of articles contained in this issue: (1) Parametric instabilities driven by more than one laser beam are analyzed for realistic laser-driven plasmas. (2) OMEGA laser-plasma X-ray yields are analyzed for their suitability in pumping novel gamma-ray laser configurations. (3) A new streak spectrograph combines an X-ray streak camera with a conically curved crystal X-ray spectrograph for time-resolved spectral analysis of laser-plasma X-rays. (4) The race for the fastest device switching times among high-speed electronic circuits is accelerated by the LLE opto-electronic sampling technique, which measured a 5-ps rise time in a permeable-base transistor. (5) Growth abnormalities in physically vapor-deposited optical thin films are a vexing problem for film environmental stability and high-power laser compatibility. DOE

N87-21325# KMS Fusion, Inc., Ann Arbor, Mich.
A SIMPLE METHOD FOR ELECTRONIC FEEDBACK STABILIZATION OF AN ACTIVELY MODELOCKED AND Q-SWITCHED Nd:YLF LASER
R. P. Johnson, N. K. Moncur, and L. D. Siebert 1987 8 p Presented at the OSA/IEEE Conference on Lasers and Electro-optics, Baltimore, Md., 27 Apr. 1987
(Contract DE-AC08-82DP-40152)
(DE87-002823; KMSF-U-1828; CONF-870401-1) Avail: NTIS HC A02/MF A01

A method is described which uses an amplitude modulated radio frequency drive signal to an acousto-optic Q-switch in a Nd:YLF laser to eliminate relaxation oscillations and stabilize output. DOE

N87-21326# Los Alamos National Lab., N. Mex.
AN OVERVIEW OF THE LONG PULSE EXPERIMENT
R. G. Watt 1986 33 p Presented at the LTH3 Meeting, Washington, D.C., 1 Dec. 1986
(Contract W-7405-eng-36)
(DE87-003738; LA-UR-86-4206; CONF-861248-1) Avail: NTIS MF A01

Simple one dimensional models of laser generated impulse for pulse lengths up to about 1 ms have shown a trend to higher coupling efficiency for fixed fluence at longer pulse lengths. This would lead to more efficient use of the available laser energy in a real defensive system. An experiment was conducted at KMS Fusion, Inc. during the period 2 to 26 September 1986 using the 1.054 micrometer wavelength Chroma laser. This experiment was designed to enable a detailed comparison between the calculational tools and measurable quantities such as the pulse length dependence of impulse generation efficiency. In particular, targets were designed to distinguish between impulse generated directly by the laser-solid interaction, and that component due to secondary coupling processes such as lateral reradiation from the hot plasma layer in front of the target, and pressure from plasma expansion along the target surface. DOE

N87-21327# Texas Univ., Austin. Inst. for Fusion Studies.
MUONIC X-RAY LASER ASSISTED BY CATALYZED FUSION OF DEUTERIUM AND TRITIUM
T. Tajima and S. Eliezer (Israel Atomic Energy Commission, Yavneh) Sep. 1986 14 p Prepared in cooperation with Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center
(Contract DE-FG05-80ET-53088)
(DE87-004851; DOE/ET-53088/255; IFSR-255) Avail: NTIS HC A02/MF A01

The possibility of an X-ray laser by irradiation of muon beams on a thin rod of deuterium-tritium mixture is discussed. The excited state of dt mu-mesomolecules (J upsilon)= (1,0) can be induced to make radiative chain transitions with photon energy of 90eV to the ground state (0,0), evaluated by fusion. DOE

N87-21328# Los Alamos National Lab., N. Mex.
MULTIFACET, METAL MIRROR DESIGN FOR EXTREME-ULTRAVIOLET AND SOFT X-RAY FREE-ELECTRON LASER RESONATORS
B. E. Newnam 1986 30 p Presented at the Symposium on Optical Materials for High Power Lasers, Boulder, Colo., 3 Nov. 1986
(Contract W-7405-eng-36)
(DE87-005100; LA-UR-87-190; CONF-861124-1) Avail: NTIS HC A03/MF A01

Resonator mirrors with reflectance greater than approx. 40% are required if free-electron laser (FEL) oscillators are to be extended to wavelengths below 100 nm. The principle of total-external reflection has been used to design multifacet mirrors of several metal films that surpass this requirement between 10 and 100 nm. These reflectors have high reflectance over a relatively broad band which suits well the inherent FEL wavelength tunability. The practical limitations to achieving and maintaining high reflectance include oxide- and carbon-contamination, scattering, and surface-plasmon absorption. DOE

N87-21329# Los Alamos National Lab., N. Mex.
LAYERED TARGET BURNTHROUGH EXPERIMENTS USING 50 nsec KrF LASER PULSES
J. F. Kephart, R. S. Dingus, S. J. Gitomer, R. A. Kopp, and M. J. Shaw (Science Research Council, Chilton, England) 1986 7 p Presented at the 9th International Conference on Lasers and Applications, Orlando, Fla., 3 Nov. 1986 Prepared in cooperation with Rutherford Appleton Lab., Chilton (UK)
(Contract W-7405-eng-36)
(DE87-005111; LA-UR-87-99; CONF-861177-7) Avail: NTIS HC A02/MF A01

Experiments have been performed on two types of planar layered targets using the Sprite KrF laser. The targets used were: (1) 0.25 to 3.0 microns of Al deposited on an SiO2 substrate, and (2) 0.25 to 3.0 microns of CH (parylene-N) deposited on 0.20 microns of Al on an SiO2 substrate. The laser was characterized by a pulse length of 50 nsec FWHM, an intensity of 2 x 10 to the 10th power Watts/sq cm and a wavelength of 248.5 nm. A filtered photoiodide and a streak camera, each operating in the visible, viewed the rear of the target. This exposure time is referred to as the burnthrough time. An estimate of the mass ablation is obtained by plotting the mass ablation depth (mass density times target thickness in micrograms/sq cm) versus the burnthrough time. These results are consistent with earlier mass loss measurements and with analytic and hydro-code calculations (LASNEX). The streak camera data shows emission at target positions larger than the laser focal spot, and thus are consistent with 1-D and 2-D calculations which show target surface ablation to be primarily driven by reradiated photons from the hot laser produced plasma. DOE

N87-21330# Lawrence Livermore National Lab., Calif.
AN OVERVIEW OF THE LAWRENCE LIVERMORE NATIONAL LABORATORY FREE ELECTRON LASER PROGRAM

H. D. Shay 18 Dec. 1986 5 p Presented at the 9th International Conference on Lasers and Applications, Orlando, Fla., 3 Nov. 1986
(Contract W-7405-eng-48)
(DE87-005815; UCRL-95845; CONF-861177-8) Avail: NTIS HC A02

This paper reviews the status of the LLNL Free Electron Laser Program. Rather than using the output of an RF linac, the electron pulse from an induction linac enters the wiggler magnet without being bunched into small packets. The laser beam makes a single pass through the FEL amplifier. Wavelengths from several millimeters to less than 1 micron can be amplified. DOE

N87-21331# Technische Hogeschool, Eindhoven (Netherlands).
THE ABSOLUTE MEASURING ACCURACY OF TECHNICAL LASER INTERFEROMETERS Ph.D. Thesis [ABSOLUTE MEETNAWWKEURIGHEID VAN TECHNISCHE LASERINTERFEROMETERS]
Petrus Henricus Johannes Schellekens 1986 194 p In DUTCH; In DUTCH Sponsored by Sampoh B.V., Groningen, The Netherlands, and Hewlett-Packard B.V., Amsterdam, The Netherlands
(ETN-87-99580) Avail: NTIS HC A09/MF A01

The development of instruments and calibration methods for laser light sources for measurement of the refractive index of air and the calibration of laser interferometers are described. The development and calibration procedure for He-Ne stabilized lasers are described, with emphasis on the reproduction limits of this light source and the shift in the absorption lines. The measurement of the frequency of He-Ne laser light sources, including warming-up effects, stability and reproducibility, are discussed. An interference refractometer was developed and successfully tested for the calibration of automatic refractive index change compensators, used with technical laser interferometers. A procedure for the comparison of technical laser interferometers is presented; it has an accuracy better than 1 part in 10 million. A test procedure for the counting system of Zeeman laser interferometers is presented. ESA

N87-21177# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.
LASER-2 FOCUS VELOCIMETRY
R. Schodl *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 31 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21178# Cranfield Inst. of Tech., Bedford (England). School of Mechanical Engineering.
SEEDING GAS FLOWS FOR LASER ANEMOMETRY
A. Melling *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21180# Cranfield Inst. of Tech., Bedford (England). School of Mechanical Engineering.
APPLICATION OF DOPPLER AND TRANSIT LASER ANEMOMETRY IN SMALL TURBOMACHINES
R. L. Elder, C. P. Forster, and M. E. Gill *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 15 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21181# Pratt and Whitney Aircraft, East Hartford, Conn.
LASER VELOCIMETRY STUDY OF STATOR/ROTOR INTERACTIONS IN A MULTI-STAGE GAS TURBINE COMPRESSOR
M. Carlson Williams *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 10 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21201# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
THE STUDY OF COMBUSTION BY MEANS OF DIODE LASER SPECTROSCOPY
B. Rosier, P. Gicquel, and D. Henry *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p Original language document was announced as A86-46182 (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N87-21332* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DUAL MOTION VALVE WITH SINGLE MOTION INPUT Patent
Robert Below, inventor (to NASA) Issued 14 Apr. 1987 10 p Filed 3 Jul. 1985 Supersedes N86-19611 (24 - 10, p 1583)
(NASA-Case-MFS-28058-1; US-Patent-4,657,044;
US-Patent-Appl-SN-751691; US-Patent-Class-137-606;
US-Patent-Class-251-165) Avail: US Patent and Trademark Office CSCL 13I

A dual motion valve includes two dual motion valve assemblies with a rotary input which allows the benefits of applying both rotary and axial motion to a rotary sealing element with a plurality of ports. The motion of the rotary sealing element during actuation provides axial engagement of the rotary sealing element with a stationary valve plate which also has ports. Fluid passages are created through the valve when the ports of the rotary sealing element are aligned with the ports of the stationary valve plate. Alignment is achieved through rotation of the rotary sealing element with respect to the stationary valve plate. The fluid passages provide direct paths which minimize fluid turbulence created in the fluid as it passes through the valve.
Official Gazette of the U.S. Patent and Trademark Office

N87-21333* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SELF INDEXING LATCH SYSTEM Patent
John C. Gibson, inventor (to NASA), John A. Calvert, inventor (to NASA), Malcolm F. Nesmith, inventor (to NASA), and Richard A. Cloyd, inventor (to NASA) Issued 15 Apr. 1986 10 p Filed 15 Feb. 1984 Supersedes N84-20860 (22 - 11, p 1664)
(NASA-Case-MFS-25956-1; US-Patent-4,582,289;
US-Patent-Appl-SN-580397; US-Patent-Class-248-550;
US-Patent-Class-248-316.4) Avail: US Patent and Trademark Office CSCL 13E

A self-latching jaw assembly is described which includes a pair of jaws for latching a fitting of an associated structure such as the keel fitting of a space telescope. The jaw assembly automatically locates the fitting received on a positioning pedestal and latches it in its original location on the pedestal without need of precision alignment. The first jaw is actuated and moved to the right whereupon a reciprocating plunger, extended from the nose of the jaw senses the hub of the spool. A jaw position responsive switch is then actuated to terminate the drive motor of the jaw. The astronaut will then actuate the drive motor of the jaw and the jaw will move to the left, whereupon the standoff will engage the face of the jaw in a latching position. In the latching position, the noses of the jaws will be under the flanges of the spool.
Official Gazette of the U.S. Patent and Trademark Office

N87-21334* National Aeronautics and Space Administration. Pasadena Office, Calif.
METHOD FOR FORMING HERMETIC SEALS Patent
Brian D. Gallagher, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena) Issued 17 Mar. 1987 8 p Filed 15 Aug. 1985 Supersedes N86-19610 (24 - 10, p 1583)
(NASA-Case-NPO-16423-1-CU; US-Patent-4,650,108;
US-Patent-Appl-SN-765978; US-Patent-Class-228-124;
US-Patent-Class-228-209; US-Patent-Class-228-208;

US-Patent-Class-427-229) Avail: US Patent and Trademark Office CSCL 11A

The firmly adherent film of bondable metal, such as silver, is applied to the surface of glass or other substrate by decomposing a layer of solution of a thermally decomposable metallo-organic deposition (MOD) compound such as silver neodecanoate in xylene. The MOD compound thermally decomposes into metal and gaseous by-products. Sealing is accomplished by depositing a layer of bonding metal, such as solder or a brazing alloy, on the metal film and then forming an assembly with another high melting point metal surface such as a layer of Kovar. When the assembly is heated above the temperature of the solder, the solder flows, wets the adjacent surfaces and forms a hermetic seal between the metal film and metal surface when the assembly cools.

Official Gazette of the U.S. Patent and Trademark Office

N87-21335 California Univ., Berkeley.

DYNAMICS OF FLEXIBLE STRUCTURES PERFORMING LARGE OVERALL MOTIONS: A GEOMETRICALLY-NONLINEAR APPROACH Ph.D. Thesis

Loc Quoc Vu 1986 231 p

Avail: Univ. Microfilms Order No. DA8624976

The modeling of flexible structures subjected to large overall motions is discussed. Applications span diverse disciplines: from robotics and machine design to aircraft and spacecraft dynamics. Traditional approaches to this class of problems are based on the assumption of small deformations, thus relying crucially on the use of a floating reference frame. The resulting set of equations of motion is nonlinear and highly coupled in the inertia terms. By contrast, an alternative approach is proposed in which fully nonlinear structural theories, which are properly invariant with respect to superposed rigid body motions, are employed. Owing to this property, the dynamics of motion can be referred directly to the inertial frame, leading to a drastic simplification of the inertia operator (with a structure identical to that found in rigid body mechanics). Even though the methodology applies to a general class of structural elements, only a one-dimensional type (flexible rod) is considered. The dynamics of Earth-orbiting flexible satellites are completely described by the same system of equations of motion as for the fully nonlinear rod model. Applications of the proposed methodology to the dynamics of flexible multibody systems (rigid bodies with flexible appendages, all flexible chain systems, flexible closed-loop chains) are also considered.

Dissert. Abstr.

N87-21336# Defence Research Establishment, Ottawa. (Ontario).

DIESEL ENGINE COMBUSTION PROGRAM AT THE DEFENCE RESEARCH ESTABLISHMENT OTTAWA

Gregory J. Smallwood, W. S. Neill, and David R. Snelling Nov. 1985 42 p

(AD-A176438; DREO-926) Avail: NTIS HC A03/MF A01 CSCL 13/9

Development of laser diagnostics for combustion and flowfield studies at the Defence Research Establishment Ottawa (DREO), and its application to a practical combustion device is described. The optical diagnostics discussed are coherent Anti-Stokes Raman spectroscopy (CARS), and various flow/spray visualization (FSV) techniques. The CARS technique provides temporally and spatially resolved measurements of temperature and major species concentrations. Various laser based FSV techniques, such as shadowgraph, Schlieren and direct visualization, and their use to study density gradients and spray behavior are described. The use in these experiments of a dual color pulsed laser transmitter can provide velocity information. The goal of the diesel combustion modelling program is to attempt to predict the effect of any candidate fuel on diesel engines performance. Experimental results from the optical diagnostics will be used to validate and improve the models. Constraints on performing optical diagnostics in diesel engines, and requirements and selection of a research diesel engine are discussed. The suitability of the Ricardo Proteus engine for this project is evaluated. The advantages of using electronic fuel injection on this research engine are also reviewed. Author

N87-21337# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.

ON IMPACT DYNAMICS OF ROBOTIC OPERATIONS Interim Report

Yu Wang Sep. 1986 45 p

(AD-A176464; CMU-RI-TR-86-14) Avail: NTIS HC A03/MF A01 CSCL 20/11

For a manipulator operation, the motion of an object to be manipulated is determined by the forces applied to the object. It is important to understand the dynamics for planning successful robot operations. The presence of friction, elasticity, as well as the inertial property of the object makes the problem difficult. This paper presents an analysis of impact dynamics incorporating these phenomena. When inertial forces dominate an impact process, contact modes of impact can be predicted in an impact space that represents all possible processes. The fundamental motion of the object is described by the way it will rotate. The effects of the above mentioned phenomena on the fundamental motion can be determined in the impact space. It is found that the prediction of the fundamental motion made by the quasi-static analysis is a lower bound for dynamic cases. The results of this analysis can be applied to the planning of robot manipulations. For simplicity, the operations and the object are constrained to a two dimensional space. GRA

N87-21338# Naval Research Lab., Washington, D. C.

MODELING AND EXPERIMENTAL VALIDATION OF A SINGLE-LINK FLEXIBLE MANIPULATOR M.S. Thesis

Kevin P. Gannon Dec. 1986 97 p

(AD-A176614) Avail: NTIS HC A05/MF A01 CSCL 05/8

Structural flexibility effects on robot mechanisms are very important considerations in the move toward lighter, faster, and more accurate robot systems. This thesis presents the computer simulation and experimental validation of a dynamic model of an experimental single-link flexible manipulator, using the Equivalent Rigid Link System with an enhanced natural-mode discretization. The experimental arm is driven by a hydraulic actuator and moves in a vertical plane. Hydraulic actuator dynamics and the effects of gravity are included in the equations of motion. Computer simulation for the experimental arm is performed by the Dynamic Simulation Language (DSL). The validation of the dynamic model includes the comparison between the actual tip position and the predicted arm tip position. GRA

N87-21339# Naval Postgraduate School, Monterey, Calif.

THE NEAR-MINIMUM TIME CONTROL OF A ROBOT ARM M.S. Thesis

Kemal Ozaslan Dec. 1986 186 p

(AD-A176875) Avail: NTIS HC A09/MF A01 CSCL 05/8

The feasibility of controlling a robot manipulator in minimum time with an adaptive computer simulation model is investigated. Updating of model parameters; position, velocity and motor gain constant are accomplished from motor position only thereby eliminating the requirement for a tachometer. The interactive nonlinear dynamics of the system such as Coupling inertia, Centripetal forces, Actuator dynamics and Gravity effects are also investigated. A two link robot manipulator is chosen as the simulation model. Author (GRA)

N87-21340# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.

THREE-DIMENSIONAL SENSING AND INTERPRETATION Final Report, 7 Apr. 1983 - 30 Sep. 1985

Gerald J. Agin Dec. 1986 133 p

(Contract F33615-83-C-1023)

(AD-A176906; AFWAL-TR-86-1099) Avail: NTIS HC A07/MF A01 CSCL 05/8

This is a final report on a project on three-dimensional sensing and interpretation under DARPA Contract F33615-83-C-1023. Four topics are discussed: a triangulation range finder mounted in the hand of a robot, a system to identify randomly-oriented cylinders in a bin, routines for extracting viewpoint-independent features of polyhedral objects using the range finder, and the use of pose

cluster matching to match and recognize three-dimensional objects. GRA

N87-21341# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
FLUID DYNAMICS OF HIGH PERFORMANCE TURBOMACHINES Annual Report, 19 Oct. 1985 - 18 Oct. 1986
Edward M. Greitzer, Alan H. Epstein, Michael B. Giles, James E. McCunme, and Choon S. Tan Nov. 1986 89 p
(Contract F49620-85-C-0018)
(AD-A177003; AFOSR-87-0038TR) Avail: NTIS HC A05/MF A01 CSCL 13/7

This report describes work which is part of a study on high performance turbomachinery fluid dynamics. Within the general topic, four separate tasks studies include: (1) loss mechanisms and loss migration in transonic compressors, including development of advanced instrumentation for measurements of wake radial transport and analysis of unsteady vortical wake structures; (2) experimental and theoretical study of flows in casing and hub treatment, including mechanisms for stability enhancement in compressors and unsteady fluid dynamic interactions between passage and groove flows; (3) computational techniques for turbomachinery, including inverse (design) calculation procedures for transonic turbomachine blades accounting for viscid/inviscid interaction; and (4) theoretical modelling of stability and unsteadiness in transonic compressor flow fields, including analyses of unsteady temperature fluctuations due to vortex shedding. GRA

N87-21342# Geo-Centers, Inc., Newton, Mass.
PERFORMANCE TEST OF 110 mm BORE BALL BEARING MADE FROM CORROSION RESISTANT POWDERED STEEL Final Technical Report, Feb. - Aug. 1986
Harold E. Munson Nov. 1986 40 p
(Contract F33615-84-C-2412)
(AD-A177060; AFWAL-TR-86-2085) Avail: NTIS HC A03/MF A01 CSCL 11/6

This final technical report summarizes the results of a 100-hour bearing performance test using an advanced corrosion resistant bearing steel. Three 110 mm bore mainshaft jet engine ball bearings made from MR2001 (produced by powder metallurgy) were refinished, and a performance test was completed on one of them. Testing performed under the current program demonstrated the ability of a full-scale jet engine bearing to operate under application conditions. Details of the testing and equipment are included in the report. GRA

N87-21343# Oak Ridge National Lab., Tenn. Fusion Energy Div.
HIGH-THROUGHPUT CONTINUOUS CRYOPUMP
C. A. Foster 1986 14 p Presented at the 28th Annual Meeting of the American Vacuum Society, Baltimore, Md., 3 Nov. 1986
(Contract DE-AC05-84OR-21400)
(DE87-000396; CONF-861196-1) Avail: NTIS HC A02/MF A01

A cryopump with a unique method of regeneration which allows continuous operation at high throughput has been constructed and tested. Deuterium was pumped continuously at a throughput of 30 Torr.L/s at a speed of 2000 L/s and a compression ratio of 200. Argon was pumped at a throughput of 60 Torr.L/s at a speed of 1275 L/s. To produce continuous operation of the pump, a method of regeneration that does not thermally cycle the pump is employed. A small chamber (the snail) passes over the pumping surface and removes the frost from it either by mechanical action with a scraper or by local heating. The material removed is topologically in a secondary vacuum system with low conductance into the primary vacuum; thus, the exhaust can be pumped at pressures up to an effective compression ratio determined by the ratio of the pumping speed to the leakage conductance of the snail. The pump, which is all-metal-sealed and dry and which regenerates every 60 s, would be an ideal system for pumping tritium. Potential fusion applications are for mpmp limiters, for repeating pneumatic pellet injection lines, and for the centrifuge pellet injector spin tank, all of which will require pumping tritium at high throughput. Industrial applications requiring ultraclean pumping of corrosive gases at high throughput, such as the reactive ion etch semiconductor process, may also be feasible. DOE

N87-21344# Los Alamos National Lab., N. Mex.
THREE DIMENSIONAL NUMERICAL SIMULATIONS OF THE UPS-292-SC ENGINE
P. J. ORourke and A. A. Amsden 1987 60 p Presented at the Society of Automotive Engineers International Congress and Expo, Detroit, Mich., 23 Feb. 1987
(Contract W-7405-eng-36)
(DE87-001968; LA-UR-86-3572; CONF-870204-1) Avail: NTIS HC A04/MF A01

We present and analyze three-dimensional calculations of the spray, mixing and combustion in the UPS-292 stratified charge engine for three different operating conditions, corresponding to overall air-fuel ratios between 22.4 and 61.0. The numerical calculations are performed with KIVA, a multidimensional arbitrary-mesh, finite-difference hydrodynamics program for internal combustion engine applications. The calculations use a mesh of 10, 000 computational cells, which conform to the shape of the piston bowl and cylinder and move to follow piston motion. Each operating condition is calculated from intake valve closure at 118 deg BTDC to 90 deg ATDC and requires approximately three hours of CRAY-XMP computer time. DOE

N87-21345# Oak Ridge National Lab., Tenn.
A REAL-TIME EXPERT SYSTEM FOR CONTROL OF AN AUTONOMOUS MOBILE ROBOT AND FOR DIAGNOSING UNEXPECTED OCCURRENCES
D. W. Kammer, G. deSaussure, and C. R. Weisbin 1986 10 p Presented at the Workshop on Automation and Robotics for Military Applications, Huntsville, Ala., 22 Oct. 1986
(Contract DE-AC05-84OR-21400)
(DE87-002411; CONF-861081-2) Avail: NTIS HC A02/MF A01

The use of an expert system for the control of an autonomous robot presents several attractive features: the explicitness and homogeneity of the knowledge representation facilitates explanation, verification and modification of the rules which determine the robot's behavior, and the domain of competence can be incrementally extended. However, real-time operation poses a number of challenges due to the dynamic nature of the data and the time constraints of dealing with a large data base. An implementation is discussed where a large commercial real-time expert system originally designed for industrial process diagnostics was adapted to the control of an autonomous mobile robot for planning, monitoring, and diagnosis of unexpected occurrences during a navigation task. Control has been successfully implemented for goal directed navigation in the presence of moving obstacles. DOE

N87-21346# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
DEVELOPMENT OF A TELEROBOTIC SYSTEM FOR HANDLING CONTAMINATED PROCESS EQUIPMENT
J. J. Fisher, C. R. Ward, and T. F. Schuler 1987 9 p Presented at the International Topical Meeting on Remote Systems and Robotics in Hostile Environments, Pasco, Wash, 29 Mar. 1987
(Contract DE-AC09-76SR-00001)
(DE87-004186; DP-MS-86-185; CONF-870301-13) Avail: NTIS HC A02/MF A01

E. I. du Pont de Nemours and Company is evaluating a unique eight-degree-of-freedom Telerobot manipulator to perform size-reduction and material handling operations on contaminated process equipment at the Savannah River Plant (SRP). The Telerobot will be installed in the proposed Transuranic (TRU) Waste Processing Facility, which is scheduled to be operational by 1990. A full-scale prototype Telerobot, manufactured by GCA Corporation, St. Paul, Minn. is being tested with other process equipment in the Components Test Facility at the Savannah River Laboratory (SRL). All telerobotic operations required in the TRU Waste Facility such as crate unpacking, equipment dismantling, material size-reduction, and selected maintenance operations are being tested. This paper discusses the major mechanical and control features of the Telerobot system. Several system enhancements were

added by SRL, including a new quick-hand-change coupling and expanded software control functions. The new software enables a system operator to perform both teleoperated and automatic tasks through several operating modes. These enhancements, as well as future mechanical, control system, and software features, are reviewed. DOE

N87-21347# Rockwell International Corp., Golden, Colo.
INERTIA FRICTION WELDING OF 1100 ALUMINUM TO TYPE 316 STAINLESS STEEL
D. Yashan, S. Tsang, W. L. Johns, and M. W. Doughty 1986 38 p Presented at the 67th Annual American Welding Society Meeting, Atlanta, Ga., 13 Apr. 1986 Prepared in cooperation with Martin Marietta Energy Systems, Inc., Oak Ridge, Tenn.
(Contract DE-AC04-76DP-03533)
(DE87-005044; RFP-4060; CONF-8604123-3) Avail: NTIS HC A03/MF A01

Joining 1100 aluminum to type 316 stainless steel by inertia friction welding was investigated. Weld quality was evaluated using a tensile specimen configuration designed to promote failure at the weld interface rather than in the aluminum base metal. Results from this work showed that good quality welds can be obtained within certain ranges of axial pressure (heating plus forge pressures), and specific energy, which is a function of flywheel moment of inertia, rotational speed, and total weld area. The use of a high specific energy led to the formation of a brittle intermetallic compound at the interface, resulting in a loss of weld strength. Three steel faying surface geometry variations were evaluated; they were found to only have a minor effect on strength. Comparisons of strength and hardness values between the inner and outer portions of the weld area revealed a variation in weld quality across the interface in most cases. DOE

N87-21348# Lawrence Livermore National Lab., Calif.
LASER WELDING METALLOGRAPHY
J. L. Ferreira 1986 16 p Presented at the International Metallographic Society Conference on Microstructural Science, Boston, Mass., 3 Aug. 1986
(Contract W-7405-eng-48)
(DE87-004113; UCRL-94386; CONF-8608153-1) Avail: NTIS HC A02/MF A01

The metallographic preparation of weld samples becomes an absolute necessity when laser welding ultra-small parts such as small diameter thin wall tubing or postage stamp-size and smaller machined components. In such welding situations, only a metallographic cross section of the weld can show the amount of penetration and the configuration of the weld nugget in relation to the weld joint. Further, metallographic examination can show cracking and porosity in the weld nugget which is generally too small for detection by conventional X-raying techniques. The speed at which weld parameters can be ascertained is also of considerable value when a test part is made and the laser is held on simmer awaiting results. This paper deals with sample preparation of various fine components that have been laser welded and discusses techniques for obtaining the most information from a sample weld. DOE

N87-21349# Bhabha Atomic Research Centre, Bombay (India).
POOL TYPE LIQUID HELIUM CRYOPUMP
1986 27 p
(DE87-701268; BARC-1305) Avail: NTIS (US Sales Only) HC A03/MF A01

Design and fabrication details of a pool type liquid helium cryopump are described. It has a liquid helium capacity of 5 liters and a pumping surface area of about 450 sq. cms. Three types of baffles having different geometries are used for radiation shielding. Effect on pumping speed for argon, carbon dioxide and nitrogen gas using the baffles is determined at various pressures. The circular array baffle geometry provides the maximum pumping speed. Using a circular array type baffle the maximum pumping speeds for nitrogen, argon and carbon dioxide are 2700 l/s, 3600 l/s, 2550 l/s respectively at a pressure of 6.0 x 10(-4) torr. The ultimate pressure obtained is 3.0 x 10(-8) torr. DOE

N87-21350# Oak Ridge National Lab., Tenn.
REAL-TIME EXPERT SYSTEM FOR THE CONTROL OF AUTONOMOUS ROBOT NAVIGATION IN THE PRESENCE OF MOVING OBSTACLES
G. deSaussure, D. W. Kammer (Albion Coll., Mich.), and C. R. Weisbin 1987 18 p Presented at the International Topical Meeting on Remote Systems and Robotics in Hostile Environments, Pasco, Wash., 29 Mar. 1987 Prepared in cooperation with Albion Coll., Mich.
(Contract DE-AC05-84OR-21400)
(DE87-002167; CONF-870301-1) Avail: NTIS HC A02/MF A01

The use of an expert system for the control of an autonomous robot presents several attractive features: the explicitness and homogeneity of the knowledge representation facilitates explanation, verification and modification of the rules which determine the robot's behavior, and the domain of competence can be incrementally extended. However, real-time operation poses a number of challenges due to the dynamic nature of the data and the time constraints of dealing with a large database. An implementation is discussed where a large commercial real-time expert system originally designed for industrial process diagnostics was adapted to the control of an autonomous mobile robot for planning, monitoring, and diagnosis of unexpected occurrences during a navigation task. Control has been successfully implemented for goal directed navigation in the presence of moving obstacles. DOE

N87-21351# Oak Ridge National Lab., Tenn.
ADVANCED MANIPULATION FOR AUTONOMOUS MOBILE ROBOTS
S. M. Babcock, W. R. Hamel, and S. M. Killough 1986 9 p Presented at the International Topical Meeting on Remote Systems and Robotics in Hostile Environments, Pasco, Wash., 29 Mar. 1987
(Contract DE-AC05-84OR-21400)
(DE87-002818; CONF-870301-3; CESAR-86/52) Avail: NTIS HC A02/MF A01

This paper describes the development, mechanical configuration, and control system architecture of a lightweight, high performance, seven-degree-of-freedom manipulator at the Center for Engineering Systems Advanced Research (CESAR). Current activities focusing on modeling and parameter identification will provide a well-characterized manipulator for analytical and experimental research in manipulator dynamics and controls, coordinated manipulation, and autonomous mobile robotics. DOE

N87-21352# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
MOBILE ROBOTS IN RESEARCH AND DEVELOPMENT PROGRAMS AT THE SAVANNAH RIVER SITE
T. P. Martin, J. S. Byrd, and J. J. Fisher 1987 11 p Presented at the International Topical Meeting on Remote Systems and Robotics in Hostile Environments, Pasco, Wash., 29 Mar. 1987
(Contract DE-AC09-76SR-00001)
(DE87-003114; DP-MS-86-184; CONF-870301-8) Avail: NTIS HC A02/MF A01

Mobile robots for deployment in nuclear applications at the Savannah River Plant (SRP) have been developed. Teleoperated mobile vehicles have been successfully used for several onsite applications. Development work using two research vehicles is underway to demonstrate semi-autonomous intelligent expert robot system operation in process areas. A description of the mechanical equipment, control systems, and operating modes of these vehicles is presented, including the integration of onboard sensors. A control hierarchy that uses modest computational methods is being developed at SRL to allow vehicles to autonomously navigate and perform tasks in known environments, without the need for large computer systems. Knowledge-based expert systems are being evaluated to simplify operator control, to assist in navigation functions, and to analyze sensory information. DOE

N87-21353# Sandia National Labs., Albuquerque, N. Mex.
MODELING AND CONTROL OF THE STANFORD/JPL HAND

C. S. Loucks, V. J. Johnson, P. T. Boissiere (New Mexico Univ., Albuquerque), G. P. Starr, and J. P. H. Steele 1987 6 p Presented at the IEEE International Conference on Robotics and Automation, Raleigh, N.C., 30 Mar. 1987 Prepared in cooperation with New Mexico Univ., Albuquerque
(Contract DE-AC04-76DP-00789)
(DE87-005847; SAND-87-0229C; CONF-870354-4) Avail: NTIS HC A02

Improved dexterity is an area of current research in robotics. Research in this area is being pursued with the aid of a Stanford/JPL hand from Salisbury Robotics. This paper presents some of the issues raised in studying the characteristics and control of a single finger of the dexterous hand. The issues presented are dynamic modeling, friction based hysteresis, and identification of the finger system. The present method for sensing and control is also discussed. DOE

N87-21354# Oak Ridge National Lab., Tenn. Engineering Physics and Mathematics Div.
REAL-TIME EXPERT SYSTEM FOR CONTROL OF AN AUTONOMOUS MOBILE ROBOT INCLUDING DIAGNOSIS OF UNEXPECTED OCCURRENCES
C. R. Weisbin, G. deSaussure, and D. W. Kammer (Albion Coll., Mich.) 1986 11 p Presented at the SPIE's Cambridge Symposium on Optical and Optoelectronic Engineering: Advanced in Intelligent Robotics Systems, Cambridge, Mass., 26 Oct. 1986
(Contract DE-AC05-84OR-21400)
(DE87-000385; CONF-8610215-1) Avail: NTIS HC A02/MF A01

An autonomous mobile robot deals with the empirical world which is never fully predictable, hence it must continually monitor its performance by comparing the actual responses of sensors to their expected responses. Where a discrepancy occurs, the source of the discrepancy must be diagnosed and on-line corrective actions or replanning may be required. The use of a production system for the control of an autonomous robot presents several attractive features: the explicitness and homogeneity of the knowledge representation facilitates explaining, verifying and modifying the rules which determine the robot's behavior; it also permits the incremental extension of the domain of competence. However, real-time operation poses a number of challenges due to the dynamic nature of the data and because the system must frequently deal with a large knowledge base in a limited time. An implementation of a control system is discussed where a large commercial real-time expert system originally designed for industrial process diagnostics was adapted to the control of an autonomous mobile robot for planning, executing and monitoring a set of navigational tasks. DOE

N87-21355# Oak Ridge National Lab., Tenn.
MANIPULATOR COMPARATIVE TESTING PROGRAM Final Report
J. V. Draper, S. J. Handel, E. Sundstrom, J. N. Herndon, Y. Fujita, and M. Maeda Feb. 1987 76 p
(Contract DE-AC05-84OR-21400)
(DE87-006026; ORNL/TM-10109) Avail: NTIS HC A05/MF A01

The manipulator systems tested included the Meidensha BILARM 83A, the Central Research Laboratories Model M-2, and the GCA PaR Systems Model 6000. Six manipulator and control mode combinations were evaluated: (1) the BILARM in master/slave mode without force reflection, (2) the BILARM in master/slave mode with force reflection, (3) the Model M-2 in master/slave mode without force reflection, (4) the Model M-2 in master/slave mode with force reflection, (5) the BILARM with switchbox controls, and (6) the PaR 6000 with switchbox controls. The experiments examined differences between master/slave systems with and without force reflection and differences between master/slave systems and switchbox controlled systems. Results of the experiments showed that operators using the Model M-2 in master/slave mode had significantly faster times to completion than operators using the BILARM in master/slave mode, with about the same error rate per trial. Operators were slower using the BILARM with force reflection than without it, and they committed more errors. There was no statistically significant difference between force-reflection and nonforce-reflection conditions for the M-2 manipulator for any of the performance criteria. DOE

N87-21356# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.
TASK EXECUTION CONTROL IN ASSEMBLY ROBOT WORK-CELLS Ph.D. Thesis - Toulouse Univ., France
Luis Ernesto LopezMellado 1986 123 p In FRENCH; ENGLISH summary
(LAAS-86-335; CNRS-Order-958; ETN-87-99411) Avail: NTIS HC A06/MF A01

The execution control task was divided into surveillance, error analysis and restart of execution (after correction of errors) to develop a sofware environment to design flexible assembling cells. The artificial intelligence approach includes a set of concepts and tools to improve the surveillance function and to ease the programming task. The procedures and experimental results are described. ESA

N87-21357# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.
CONTRIBUTION TO THE IMPLEMENTATION OF DYNAMIC VISION IN THE THREE-DIMENSIONAL PERCEPTION SYSTEM OF THE HILARE ROBOT Ph.D. Thesis [CONTRIBUTION A L'INTEGRATION DE LA VISION DYNAMIQUE AU SYSTEME DE PERCEPTION 3D DU ROBOT HILARE]
Nora SiAhmed 1986 149 p In FRENCH; ENGLISH summary
(CNRS-Order-959; ETN-87-99412) Avail: NTIS HC A07/MF A01

The definition of the dynamic vision system integrated in a multisensor experimental mobile robot is studied. The analysis includes the cooperation with the other modules to allow the formulation of models for localization or detection of mobile objects and the estimation of true trajectories in space starting from apparent displacement in a sequence of images. The results include procedures for identification of complex movement parameters. ESA

N87-21358# Ecole Centrale de Lyon (France). Dept. de Mathematiques, Informatique, Systemes.
MATHEMATICAL AND NUMERICAL STUDY OF A SINGLE SIDE CONTACT FRICTION PROBLEM IN ELASTICITY AND ELASTOPLASTICITY Ph.D. Thesis [ETUDE MATHEMATIQUE ET NUMERIQUE D'UN PROBLEME DE CONTACT UNILATERAL AVEC EN ELASTICITE ET ELASTOPLASTICITE]
Laurent Jeannin 1985 167 p In FRENCH
(ECL-85-09; ETN-87-99416) Avail: NTIS HC A08/MF A01

The problem of deformable bodies in contact with a foundation where forces may be applied holding the body and producing Coulomb type friction is studied. A variational formulation is presented. Bounded and unbounded penalization methods are developed. Numerical solutions are obtained using the finite element method. The convergence of the simplified discrete problem solutions is demonstrated. The algorithms employed are described. The method is generalized to elastoplastic materials following a Hencky behavior. Numerical results are given. ESA

N87-21359# Ecole Centrale de Lyon (France). Lab. de Mecanique des Solides.
WEAR INDUCED BY SMALL AMPLITUDE VIBRATIONS: PHENOMENA IDENTIFICATION Ph.D. Thesis [USURE INDUITE SOUS PETITS DEBATTEMENTS. IDENTIFICATION DES PHENOMENES]
Christian Colombie 1986 129 p In FRENCH
(ECL-86-11; ETN-87-99418) Avail: NTIS HC A07/MF A01

Fretting corrosion phenomena are studied, investigating mechanical, chemical, and surface interaction contributions. Stainless steels, Al and Ti alloys, and plastics such as polycarbonates were examined. The microstructure of the tested materials was studied. It is shown that the wear is characterized by a three bodies contact established as soon as initial contact produces wear. As a function of surface contraints the degradation consists

of a region of severe surface wear plus a cracking process extended in depth. ESA

N87-21360# Ecole Centrale de Lyon (France). Lab. de Metallurgie Physique.
STUDY OF CERAMIC-METAL BONDING: APPLICATION TO COPPER-ALUMINA BONDING Ph.D. Thesis [ETUDE DES LIASONS CERAMIQUE-METAL. APPLICATION AU COUPLE CUIVRE-ALUMINE]
Michel Courbiere 1986 219 p In FRENCH
(ECL-86-13; ETN-87-99420) Avail: NTIS HC A10/MF A01

Ceramic-metal assembling techniques are reviewed and the CuO eutectic melt and pressure welding techniques are examined. The physical and chemical mechanisms involved are studied showing that the mixed behavior of Pa illustrates well the two possible types of reaction between a metal and a ceramic oxide. Experiments on Cu/Al2O3 bonding are described and the interfaces are examined, highlighting the complex mechanisms governing the joint characteristics. ESA

N87-21361# Technical Research Centre of Finland, Espoo. Lab. for Engineering Production Technology.
SUBMERGED ARC WELDING OF HIGH STRENGTH STRUCTURAL STEELS
Martti Vilpas, Albert Heuser, Helmut Nies, and Risto Karppi Sep. 1986 51 p Sponsored by the German Ministry of Research and Technology, the Finnish Ministry of Trade and Industry, and the Federation of Finnish Metal and Engineering Industries
(VTT-436; ISBN-951-38-2708-9; ISSN-0358-5077; ETN-87-99361) Avail: NTIS HC A04/MF A01

Submerged arc weld tests of 40 mm thick high strength steels are summarized. Results show that arc energy should be reduced to 15 to 25 kJ/cm to obtain sufficient heat affected zone (HAZ) toughness in SA-welded butt joints of steel StE 690. The recommended arc energy range for steels StE 470 and StE 460 is found to be 10 to 30 kJ/cm. The steels E StE 355 and RR St 52-3U result in favorable toughness behavior for all the arc energies studied, i.e., 17 to 50 kJ/cm for E StE 355 and 80 kJ/cm for RR St 52-3U. The arc energy is however, recommended to be reduced to values between 10 to 40 kJ/cm when a transition temperature T27J less than minus 60 C is required with these steels. The transition behavior of weld metals is found to be in all cases more favorable than those of HAZ in the arc energy range recommended for HAZ toughness. ESA

N87-21190# Cranfield Inst. of Tech., Bedford (England). Signal Processing and Applications Group.
ACQUISITION AND ANALYSIS OF DYNAMIC ROTATING MACHINERY DATA
R. Wallace *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 11 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21191# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
ACQUISITION AND PROCESSING OF NON-STATIONARY PRESSURE MEASURMENTS IN STUDIES OF AIR INTAKE DISTORTION [ACQUISITION ET TRAITEMENT DES MESURES DE PRESSIONS NON STATIONNAIRES DANS LE CADRE DES ETUDES DE DISTORSION DENTREES DAIR]
J. L. Eyraud, F. Auzolle, and M. Wagner (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 7 p In FRENCH (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21195# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
THE UTILIZATION OF THIN FILM SENSORS FOR MEASUREMENTS IN TURBOMACHINERY [UTILISATION DES CAPTEURS PELLICULAIRES POUR LA MESURE SUR TURBOMACHINES]
A. Bruere, M. Portat, J. C. Godefroy, and F. Helias *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 9 p In FRENCH Original language document was announced as A86-46180 (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21196# Oxford Univ. (England). Dept. of Engineering Science.
INTERFEROMETRIC MEASUREMENT OF STRAINS AND DISPLACEMENTS IN ENGINE COMPONENTS.
C. Ruiz, P. H. Webb, and D. Post (Virginia Polytechnic Inst. and State Univ., Blacksburg) *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 13 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21198# Rolls-Royce Ltd., Bristol (England). Advanced Projects Dept.
THE APPLICATION OF RADIATION PHYSICS AND PHOTOGRAMMETRIC TECHNIQUES FOR THE DIAGNOSIS AND SOLUTION OF MECHANICAL ENGINEERING PROBLEMS AND PERFORMANCE IMPROVEMENTS IN THE DEVELOPMENT OF AERO GAS TURBINE ENGINES AT ROLLS ROYCE
P. A. E. Stewart *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 19 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

N87-21199# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
TIP CLEARANCE MEASUREMENT IN MODERN COMPRESSOR COMPONENTS
Hartwig Knoell and Kurt Ding *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 70 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N87-21362# Analytic Sciences Corp., Reading, Mass.
RELIABILITY GROWTH PREDICTION Final Technical Report, 1984 - 1986
R. K. Gates, G. J. Gibson, and K. K. McLain Sep. 1986 120 p (Contract F30602-84-C-0032)
(AD-A176128; TASC-TR-5054-1-1; RADC-TR-86-148) Avail: NTIS HC A06/MF A01 CSCL 14/4

A reliability growth data base on nine avionic systems and thirty equipment items was compiled for the study. Several growth models were investigated and three were selected for application to the data: The Duane, AMSAA and IBM models. Goodness-of-fit tests for the models were applied and relationships between growth model parameters and equipment characters/program attributes were investigated. Both the Duane and AMSAA models were found to yield reasonably good fits to the data sets. Both models, however, were found to have limited utility as predictive tools. Anomalies in the growth data, such as burn-in effects and time delays in incorporating corrective actions tended to mask out any relationships between the growth parameters and equipment characteristics or program attributes. The IBM model was found to provide a more workable methodology for growth prediction. A prediction procedure was developed, based upon IBM model, which uses engineering information available at the start of the growth program. Guidelines for conducting reliability growth tests and examples of the reliability growth prediction procedures are provided in the report. Author (GRA)

N87-21363# South Carolina Univ., Columbia.
SOME RESEARCH PROBLEMS IN RELIABILITY THEORY AND

IN LIMIT THEORY Final Report, 1 Nov. 1985 - 31 Oct. 1986
James Lynch Dec. 1986 3 p
(Contract DAAL03-86-K-0010)
(AD-A176439; ARO-23448.3-MA) Avail: NTIS HC A02/MF A01 CSCL 12/1

This report describes 3 papers. In paper 1, functional Erdoes-Renyi type laws were established. In a revised version, the importance of establishing the compactness condition in the large deviation principle is emphasized for such laws. In addition, some large deviation results are obtained in situations where the compactness condition does not hold. In paper 2, how the dispersiveness of the mixing distribution carries over to the mixed model is qualified in terms of generalized convex functions. A sign change result is given which can be used as a diagnostic to determine if you've gone far enough when fitting a mixed model. In paper 3, a strategy is given for analyzing mixtures of exponential distributions. The strategy is primarily based on graphical procedures. GRA

N87-21364# North Carolina Univ.,. Raleigh. Operations Research.
THE TAGUCHI APPROACH TO QUALITY CONTROL AND ENHANCEMENT: A PRIMER
Salah E. Elmaghraby, Yahya Fathi, and William G. Ferrell, Jr. Nov. 1986 50 p
(Contract DAAL03-86-K-0039)
(AD-A176571; NUSC-OR-213; ARO-22835.1-MA) Avail: NTIS HC A03/MF A01 CSCL 14/4

A revolution in quality control and enhancement has been in progress in Japan for some 25 years, and has recently come to the US. It is identified with the name of G. Taguchi, an engineer cum statistician, who advocated a radical departure from the prevailing culture of the detection of assignable causes of variation with the view of eliminating them, to the engineering of quality, where the emphasis is on the design of the product to be robust against such causes of variation. The basic tenets of the Taguchi approach are reviewed, and contrasted with classical and well entrenched approaches such as response surface and evolutionary operation. The paper also raises the issue of the possible extension of the Taguchi approach to process (rather than product quality control.) For ease of reading, the paper is divided into two parts. The first is discursive and non-mathematical, and is aimed at the reader who wishes to gain a deeper understanding of what it is all about without the detailed mathematical formalism. The second presents the mathematical underpinnings of the approach, which are rather elementary. No statistical methodology is expounded upon because the reader is assumed to be cognizant of the requisite statistical facts. GRA

N87-21365# Naval Postgraduate School, Monterey, Calif.
COMPOSITE SERVICE LIFE PREDICTION VIA FIBER BUNDLE TESTING. EVALUATION OF TESTING EQUIPMENT AND DATA ACQUISITION SYSTEM M.S. Thesis
Dimitrios M. Petridis Dec. 1986 177 p
(AD-A176835) Avail: NTIS HC A09/MF A01 CSCL 11/4

The objective of this thesis is to investigate the problem of the safe service life prediction of graphite composite structures such as pressure vessels used in the pilot ejection seats, rocket motor cases and space shuttle energy storage compartments. The basic data required for life prediction is the stress-rupture life, i.e., the composite life under constant load and it has to be recognized that extensive testing over long periods of time is required to produce statistically meaningful data. The contribution of this investigation is focused on identifying the characterization methodology for efficient data generation (to minimize cost and time), the appropriate theoretical models for correlation of the data (to translate data to applications) and in evaluating the limitations of the available testing (lower bound response speed) and data acquisition equipment (upper bound recording rate) thereby enhancing future experimental planning and testing. GRA

N87-21366# Idaho National Engineering Lab., Idaho Falls.
ULTRASONIC DETECTION OF WELD BEAD GEOMETRY
N. M. Carlson and J. A. Johnson 1986 8 p Presented at the Conference on Review of Progress in Quantitative NDE, San Diego, Calif., 3 Aug. 1986
(Contract DE-AC07-76ID-01570)
(DE87-000441; EGG-M-11186; CONF-860856-7) Avail: NTIS HC A02/MF A01

The three basic components needed to truly automate a welding machine are being investigated in a joint research effort involving the Idaho National Engineering Laboratory (INEL) and the Massachusetts Institute of Technology (MIT). These are: sensors to detect the physical properties of the weld, a model of the welding process, and a control system that can take signals from the sensors, for use in the feedback control, to the welder. Research programs at the INEL are developing electro-optic and ultrasonic sensors to detect the physical properties of the weld and a model of the welding process to relate these properties to parameters in the control model being developed at MIT. This paper discusses the ultrasonic sensing techniques which detect weld bead geometry on root passes during the gas metal arc (GMA) welding process and the approach for acquiring and evaluating the ultrasonic signal and assessing its quality for use as an input signal to a closed loop controlled welding system. DOE

N87-21367# Argonne National Lab., Ill.
ULTRASONIC NDE OF GREEN-STATE CERAMIC USING FOCUSED THROUGH-TRANSMISSION
R. A. Roberts Sep. 1986 19 p Presented at the Conference on Review of Progress in Quantitative NDE, San Diego, Calif., 3 Aug. 1986
(Contract W-31-109-eng-38)
(DE87-001494; CONF-860856-11) Avail: NTIS HC A02/MF A01

The use of focused ultrasound fields in conjunction with the vacuum-coupled film encapsulating technique provides an effective means for the detection of isolated inclusions and localized inhomogeneities in green-state ceramic materials. Inclusions in the 100 micron to 1000 micron dia range have been successfully imaged in 0.25 in. thick green-state specimens. Likewise, localized nonuniformities in compaction density can be effectively imaged. The integration of such techniques into ceramic processing prior to densification could have a significant impact on both product cost and reliability. DOE

N87-21368# National Bureau of Standards, Gaithersburg, Md. Semiconductor Electronics Div.
NONDESTRUCTIVE EVALUATION ACTIVITIES IN THE SEMICONDUCTOR MATERIALS AND PROCESSES DIVISION Annual Report
R. D. Larrabee and M. I. Bell Dec. 1986 33 p
(PB87-140174; NBSIR-86-3495; AR-1) Avail: NTIS HC A03/MF A01 CSCL 14D

This is the first in a planned series of annual reports describing the nondestructive evaluation and measurement development activities of the National Bureau of Standards in the area of semiconductor materials and devices. Present activities include production and certification of standard reference materials, development of new measurement techniques, and coordination of interlaboratory experiments and other activities of voluntary standards organizations. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N87-21369 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
CALCULATION OF THE EFFECT OF A POINT IMPACT ON AN

INFINITE ELASTIC PLATE ADJACENT TO A SEMI-INFINITE FLUID

A. G. P. Warham Dec. 1986 180 p

(NPL-DITC-80/86; ISSN-0262-5369; ETN-87-99801) Copyright. Avail: Issuing Activity

A computer program was written to calculate the response to an impulsive force of a damped elastic infinite plate adjacent to a semi-infinite fluid. It can be used to compute either the displacement at a point on the plate or the pressure at a point in the fluid. The computational methods, which involve a wide variety of numerical techniques and analytic approximations, are described. Results are illustrated and comparisons made with Mackeritch and Hayek (1981) which appear to be in error. ESA

N87-21370 National Physical Lab., Teddington (England). Div. of Materials Applications.

THE EFFECTS OF CURVATURE ON THE STIFFNESS OF LATERALLY LOADED RECTANGULAR PLATES

D. H. Ferriss Dec. 1986 15 p

(NPL-DMA(A)-122; ISSN-0143-7313; ETN-87-99806) Copyright. Avail: Issuing Activity

Equations describing the equilibrium of a laterally loaded cylindrical shell are presented. The shell is assumed either uniformly loaded or point loaded at the center and the shell edges are assumed simply supported. Solution of these equations enables the displacement at the shell center to be determined and compared with results for flat plates. ESA

N87-21371 Pennsylvania State Univ., University Park.

SCATTERING MATRIX AND FINITE-ELEMENT APPROACHES TO STUDY TARGET STRENGTHS OF HOMOGENEOUS, COMPOSITE AND STIFFENED SHELLS Ph.D. Thesis

S. Baskar 1986 142 p

Avail: Univ. Microfilms Order No. DA8623716

The scattering of acoustic waves by elastic shells immersed in a fluid is analyzed. A new approach has been proposed, using thin shell theory, which incorporates the impedance of the shell in T-matrix formulation. The impedance of the shell is calculated for simple geometries of spherical and cylindrical shells by the closed form solutions in terms of classical functions of Legendre and trigonometric functions, respectively. In the case of a complex geometric shape, a hemispherically capped cylindrical shell, the finite element eigen-function is introduced to solve for the impedance of the shell. Numerical results are presented for the target strengths or the back-scattered farfield amplitudes as a function of frequency. Calculations were made for two-dimensional infinitely long cylindrical shells. The impedance method for a circular cylindrical shell has been compared with the full elasticity solution using the separation of variables approach. The target strengths of circular cylindrical shells have been compared with and without stiffeners. Using the orthotropic analysis of composite shells, the impedance of the shell is derived to study the scattering response by the laminated composite shell. Dissert. Abstr.

N87-21372 California Univ., Berkeley.

STRAIN AND STRESS CYCLING IN ELASTIC-PLASTIC MATERIALS Ph.D. Thesis

Daniel J. Nikkel, Jr. 1986 94 p

Avail: Univ. Microfilms Order No. DA8624877

Within the framework of the strain-space formulation of an existing rate-type theory of plasticity, the response of elastic-plastic materials in one-dimensional stress and strain cycling and two-dimensional strain cycling is investigated. Utilizing relatively simple constitutive equations, detailed theoretical calculations are made which predict certain types of material response which occur during stress and strain cycling in a homogeneous deformation sustained by a uniaxial state of stress, and during strain cycling in a homogeneous deformation that can be sustained by a biaxial state of stress. In the case of the uniaxial stress problem, the predictions include the material response in stress cycling between fixed values of stress (not necessarily equal in magnitude) resulting in ratcheting of the strain, and a type of saturation hardening caused by strain cycling between two fixed values of strain which the mean value of the stress (in tension and compression) tends to zero. Calculated results for the biaxial strain cycling problem predict saturation hardening and erasure of memory. The predicted theoretical calculations, carried out in the context of small deformation, are in good agreement with corresponding available experimental results. Dissert. Abstr.

N87-21373*# Textron Bell Helicopter, Fort Worth, Tex.

SUMMARY OF THE MODELING AND TEST CORRELATIONS OF A NASTRAN FINITE ELEMENT VIBRATIONS MODEL FOR THE AH-1G HELICOPTER, TASK 1 Final Report

J. D. Cronkhite, V. L. Berry, and R. V. Dompka Jan. 1987 278 p (Contract NAS1-17496)

(NASA-CR-178201; NAS 1.26:178201; Rept-699-099-202) Avail: NTIS HC A13/MF A01 CSCL 20K

The AH-1G NASTRAN finite element model (FEM) is described and the correlations with measured data that were conducted to verify the model are summarized. Comparisons of the AH-1G NASTRAN FEM calculations with measured data include the following: (1) fuselage and tailboom static load deflection (stiffness) testing, (2) airframe ground vibration testing (0-30 H<), (3) airframe flight vibration testing (main rotor, 2,4, and 6/rev), and (4) tailboom effective skin static testing. A description of the modeling rationale and techniques used to develop the NASTRAN FEM is presented in conjunction with all previous correlation work. In general, the correlations show good agreement between analysis and test in stiffness and vibration response through 15 to 20 Hz. For higher frequencies (equal to or greater than 4/rev (21.6 Hz)), the vibration responses generally did not agree well. Also, the lateral (2/rev (10.8 Hz)) flight vibration responses were much lower in the FEM than test, indicating that there is a significant excitation source other than at the main rotor hub that is affecting the lateral vibrations, such as downwash impingement on the vertical tail. Author

N87-21374# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

IMPROVEMENT OF FATIGUE LIFE PREDICTION ACCURACY FOR VARIOUS REALISTIC LOADING SPECTRA BY USE OF CORRECTION FACTORS

A. Buch Nov. 1985 63 p

(TAE-581) Avail: NTIS HC A04/MF A01

Some examples of using the correction factor method for improving the direct Nominal-Stress Approach (LSA) predictions are considered in the report. The N sub exp/N sub calc ratio for a relevant loading spectrum was used for more correct prediction of the considered fatigue life for a not too different loading frequency distribution. It was shown that the application area of the relative method is similar both for the Nominal-Stress and Local-Strain approaches. In the second case a correction is especially needed for obtaining more reliable estimates. For both approaches, it is possible to obtain much improved predictions when the two compared loading cases differ only in the reference stress level, or when the reference stress level and some other important loading spectrum parameters are identical but the loading frequency distribution differs somewhat. For the cases of the same loading spectrum but different materials or different stress concentrations, prediction of the material effect or of the stress concentration effect is also possible, especially from the qualitative viewpoint. Author

N87-21375*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A NASTRAN PRIMER FOR THE ANALYSIS OF ROTATING FLEXIBLE BLADES

Charles Lawrence, Robert A. Aiello, Michael A. Ernst, and Oliver G. McGee (Ohio State Univ., Columbus) May 1987 23 p

(NASA-TM-89861; E-3528; NAS 1.15:89861) Avail: NTIS HC A02/MF A01 CSCL 20K

This primer provides documentation for using MSC NASTRAN in analyzing rotating flexible blades. The analysis of these blades includes geometrically nonlinear (large displacement) analysis under centrifugal loading, and frequency and mode shape (normal

modes) determination. The geometrically nonlinear analysis using NASTRAN Solution sequence 64 is discussed along with the determination of frequencies and mode shapes using Solution Sequence 63. A sample problem with the complete NASTRAN input data is included. Items unique to rotating blade analyses, such as setting angle and centrifugal softening effects are emphasized. Author

N87-21376*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRELIMINARY REPORT ON CANDIDATES FOR AGARD STANDARD AEROELASTIC CONFIGURATIONS FOR DYNAMIC RESPONSE
E. Carson Yates, Jr. Apr. 1987 42 p Presented at the 61st Meeting of the AGARD Structures and Materials Panel, Oberammergau, West Germany, 9-13 Sep. 1985
(NASA-TM-89142; NAS 1.15:89142) Avail: NTIS HC A03/MF A01 CSCL 20K

At the request of the Aeroelasticity Subcommittee of the AGARD Structures and Materials Panel, a survey of member countries has been conducted to seek candidates for a prospective set of standard configurations to be used for comparison of calculated and measured dynamic aeroelastic behavior with emphasis on the transonic speed range. This set is a sequel to that established several years ago for comparisons of calculated and measured aerodynamic pressures and forces. Approximately two dozen people in the United States, and more than three dozen people in the other member countries, were contacted. This preliminary report presents the results of the survey and an analysis of those results along with recommendations for the initial set of standard configurations and for additional experimental work needed to fill significant gaps in the available information. Author

N87-21377*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONVERGENCE OF STRAIN ENERGY RELEASE RATE COMPONENTS FOR EDGE-DELAMINATED COMPOSITE LAMINATES
I. S. Raju, J. H. Crews, Jr. (Analytical Services and Materials, Inc., Hampton, Va.), and M. A. Aminpour Apr. 1987 41 p
(NASA-TM-89135; NAS 1.15:89135) Avail: NTIS HC A03/MF A01 CSCL 20K

Strain energy release rates for edge delaminated composite laminates were obtained using quasi 3 dimensional finite element analysis. The problem of edge delamination at the -35/90 interfaces of an 8-ply composite laminate subjected to uniform axial strain was studied. The individual components of the strain energy release rates did not show convergence as the delamination tip elements were made smaller. In contrast, the total strain energy release rate converged and remained unchanged as the delamination tip elements were made smaller and agreed with that calculated using a classical laminated plate theory. The studies of the near field solutions for a delamination at an interface between two dissimilar isotropic or orthotropic plates showed that the imaginary part of the singularity is the cause of the nonconvergent behavior of the individual components. To evaluate the accuracy of the results, an 8-ply laminate with the delamination modeled in a thin resin layer, that exists between the -35 and 90 plies, was analyzed. Because the delamination exists in a homogeneous isotropic material, the oscillatory component of the singularity vanishes. Author

N87-21378# Aerospace Structures Information and Analysis Center, Wright-Patterson AFB, Ohio.
A TWO-DIMENSIONAL LINEAR ELASTIC CRACK TIP ELEMENT FOR NASTRAN Interim Technical Report, Mar. - May 1985
Peter J. Woytowitz and Richard L. Citerley Jul. 1986 63 p
(Contract F33615-84-C-3216)
(AD-A176133; ASIAC-685.1D; AFWAL-TR-86-3018) Avail: NTIS HC A04/MF A01 CSCL 20/11

Linear elastic fracture mechanics has gained a substantial acceptance in industry and has become one of the most important design considerations. Many engineering structures such as airplanes, turbines, piping (pressure vessels), bridges, etc., contain pre-existing flaws. As a result of even rather moderate service loads, crack propagation resulting from these flaws can have a dramatic effect on the service life of the component. To account for this reduction in service life, fracture mechanics analysis in conjunction with a fracture control plan is generally implemented. A new crack element has been developed and incorporated into COSMIC/NASTRAN. The element is considered linear, isotropic, and homogeneous. Mode I and II stress intensity factors are automatically calculated. Comparisons to theoretical plane strain solutions for several geometries are presented and demonstrate the accuracy of the developed element. Extensions of the element to three dimensions, anisotropic material, and plastic analysis are discussed. GRA

N87-21379# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesion Science.
NONLINEAR VISCOELASTIC ANALYSIS OF ADHESIVELY BONDED JOINTS Interim Report
S. Roy and J. N. Reddy Nov. 1986 65 p
(Contract N00014-82-K-0185)
(AD-A176494; CAS/ESM-86-4; VPI-E-86.28) Avail: NTIS HC A04/MF A01 CSCL 11/1

The report deals with the development of a numerical/computational procedure based on the updated Lagrangian formulation of two-dimensional continuum theory and nonlinear viscoelastic model of Schapery for the stress and deformation analysis of adhesively bonded joints. Schapery's uniaxial, single-integral law for nonlinear viscoelastic behavior is modified for two dimensions and included in the incremental, updated Lagrangian formulation that includes geometric nonlinear effects. The finite element method is used to solve the resulting differential equations, and a number of validation and sample problem results are presented. GRA

N87-21380# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
NORMAL WAVE PROPAGATION VELOCITY IN A STATIC WEB M.S. Thesis
Glen D. Francis Dec. 1986 49 p
(AD-A176539; AFIT/CI/NR-87-9T) Avail: NTIS HC A03/MF A01 CSCL 20/11

Web tension measurement and control has been a major problem in web processes since the first conceptual phases of web handling. The systems currently in use require contact with the web and generally produce an average tension measurement across the span of the web. This study investigated the variance of normal wave propagation velocity with respect to variation of tension. The theory is that the normal wave propagation velocity will increase with increasing web tension and decrease with decreasing tension. Experiments were performed on a static web and incorporated both standing and propagating wave techniques. The goal of this research was to provide information for the development of a device to measure web tension without contacting the web surface and which would provide information as to the tension variance across the span of the web. GRA

N87-21381# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
WAVE PROPAGATION IN PERIODIC TRUSS STRUCTURES M.S. Thesis
Joel Signorelli Feb. 1987 99 p
(AD-A176548; AFIT/CI/NR/87-016T) Avail: NTIS HC A05/MF A01 CSCL 20/11

Wave propagation in periodic truss-work beams was analytically investigated. Transfer matrix methods were applied to the analysis of two truss beams. The results of a truss with members modelled as pinned rods agree well with results obtained from equivalent continuum models of the same structure. Use of beam models for the truss members shows that the pinned rod truss model loses fidelity at the first resonant frequency of the lateral motion of the truss members. The pinned beam truss exhibits complicated mechanical filtering properties. Each travelling wave mode experiences alternating stop, pass, and complex mode bands as a function of frequency. It was shown that complex modes cannot exist alone and must form in groups of four. Net power flow in

right/left-going complex mode pairs is found to be zero. Scattering matrices were determined for fixed and free boundary conditions. The phase closure principle was then used to determine natural frequencies of the truss. It was found that closely spaced resonant frequencies were not identified by this method. Computed results show subtle erroneous characteristics which are attributed to numerical effects. Author (GRA)

N87-21382# California Inst. of Tech., Pasadena. Aeronautical Labs.
AN EXPERIMENTAL AND ANALYTICAL PROGRAM TO DEVELOP CRACK TIP FRACTURE CRITERIA Annual Progress Report, Apr. - Dec. 1985
C. Schultheisz, T. Ungsuwarungsri, and W. G. Knauss Mar. 1986 9 p
(Grant AF-AFOSR-0254-84)
(AD-A176853; AFOSR-87-0141TR) Avail: NTIS HC A02/MF A01 CSCL 20/11

A summary of progress is given on the development of instrumentation to determine with great accuracy the in-plane and out-of-plane surface deformations in the vicinity of a crack tip. The purpose is to establish a data base for: (1) guiding theoretical research in characterizing the deformation fields in the crack tip vicinity for fracture research, and (b) to provide factual information for the evaluation of currently proposed theories dealing with crack tip deformation. The experimental tools under development are moire interferometry for the in-plane deformations and optical interferometry computer-based data processing unit, which is able to record and process in nearly real time fringe patterns into strain fields, and, for known - or estimated - constitutive behavior into stress fields. This report summarizes the state of developments and establishes that it is in phase with projected progress. GRA

N87-21383# Wisconsin Univ., Madison. Dept. of Engineering Mechanics.
FULL-FIELD STRESS-STRAIN ANALYSIS OF CRACKING PLATES Final Report, 1 Sep. 1985 - 31 Aug. 1986
Bela I. Sandor, G. D. Farnham, and K. C. Schmid 11 Nov. 1986 41 p
(Grant AF-AFOSR-0328-85)
(AD-A176986; UW/86-120-028; AFOSR-87-0076TR) Avail: NTIS HC A03/MF A01 CSCL 20/11

This research seeks to lay the groundwork for experimentally tracking changing gradient fields of stress and strain as damage evolves in a flat edge-cracked plate under uniaxial loading. The task is difficult because at many points there are biaxial stresses that are in-phase, non-proportional, and possibly perturbed by localized plastic strains. Significant progress can be made by employing the new technique of differential infrared thermography (DIT), commonly known as the SPATE method (Stress Pattern Analysis by Thermal Emissions). DIT provides output that is proportional to the peak-to-peak sum of the elastic stress change (delta(sigma(1) + sigma (2))) on the surface of a cyclically loaded member. Thus it is important to focus first on the resolution of the sigma (x) and sigma (y) distributions of a biaxial field. Study results demonstrate that DIT (using the SPATE method) is effective for investigating complex biaxial stress-strain fields and regions involving large stress-strain gradients. The validity of the SPATE method for elastic deformations of notched specimens has been proven. The SPATE isopachic data have been separated into individual and sigma(Y) distributions using simple procedures. In most cases the error in these analyses is approximately 1 to 3%. GRA

N87-21384# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
A FINITE ELEMENT ANALYSIS OF SMALL-SCALE YIELDING NEAR A STATIONARY CRACK UNDER PLANE STRESS
R. Narasimhan and A. J. Rosakis Jun. 1986 68 p
(Contract N00014-85-K-0596)
(AD-A177011; SM-86-21) Avail: NTIS HC A04/MF A01 CSCL 20/11

A detailed finite element analysis of the monotonic loading of a stationary crack is performed under Mode 1 plane stress, small-scale yielding conditions. A small strain J sub 2 incremental plasticity theory is employed and both elastic-perfectly plastic and power law hardening materials are considered. Some issues such as the range of dominance of the asymptotic stress and deformation fields and the amount of non-proportional loading near the crack tip, which have received wide attention in the analogous plane strain problem, are examined. Special attention is devoted to the perfectly plastic idealization by performing a separate singular finite element analysis to clarify some details about the asymptotic stress and deformation fields. The full-field numerical solution is used to simulate synthetic (optical) caustic patterns at different distances from the tip, which are compared with experimental observations and with asymptotic analytical results. GRA

N87-21385# Tufts Univ., Medford, Mass.
ELASTIC INTERACTIONS OF A CRACK WITH DAMAGE AND ASSOCIATED ENERGY RELEASE RATES Final Report, 1 Sep. 1984 - 30 Sep. 1986
Mark Kachanov 24 Dec. 1986 23 p
(Grant AF-AFOSR-0321-84)
(AD-A177071; AFOSR-87-0004TR) Avail: NTIS HC A02/MF A01 CSCL 20/11

A new method of analysis of many crack problems has been developed. It is based on the ideas of self-consistency applied to average tractions on individual cracks and yields simple analytical solutions accurate up to quite close distances between cracks. The configuration crack-microcrack array was studied in detail and the effects of stress shielding and stress amplification due to microcracking were investigated. GRA

N87-21386# Technion Research and Development Foundation Ltd., Haifa (Israel).
THERMOMECHANICAL EFFECTS IN INELASTIC MATERIALS AND STRUCTURES Annual Report, 1 Jun. 1985 - 30 Dec. 1986
Sol R. Bodner 20 Nov. 1986 18 p
(Grant AF-AFOSR-0042-84)
(AD-A177076; AFOSR-87-0022TR) Avail: NTIS HC A02/MF A01 CSCL 07/1

The following subjects were treated: examination of material behavior at extreme conditions of temperature and strain rate with respect to a set of elastic-viscoplastic constitutive equations; generalization of those equations to large deformations with particular attention to temperature effects and with applications to cyclic loading and the response of two phase materials; stress waves in composite materials; and the effects of damage development on the response of metals and composites. GRA

N87-21387# Bundesanstalt fuer Materialpruefung, Berlin (West Germany).
MULTITECHNIQUE STUDIES ON FRETTING FATIGUE: INFLUENCE OF SURFACE TREATMENT Final Technical Report, Jan. 1983 - Mar. 1986
Harro Sander Nov. 1986 69 p
(Contracts DAJA45-83-C-0019; DA Proj. 1L1-61102-BH-57)
(AD-A177103; R/D-4038-AN) Avail: NTIS HC A04/MF A01 CSCL 20/11

In the experimental program a specially constructed apparatus was used to simulate conditions at the faying surfaces in a structural joint. Fretting fatigue tests were carried out on 34 Chromium Nickel Molybdenum 6/100Cr6 steels using stress ratios from the range of finite endurance. Two methods of surface treatments are used: polishing and shaping. Two directions of each surface treatment are considered: parallel and perpendicular to the sliding direction. The results are compared to baseline tests on the same material without fretting and are discussed in terms of the effect of surface roughness and normal force. GRA

N87-21388# Systems Engineering Labs., Inc., Greenbelt, Md.
MODELING AND CONTROL OF FLEXIBLE STRUCTURES Annual Report, Oct. 1984 - Oct. 1985
W. H. Bennett, G. L. Blankenship, and H. G. Kwatny 16 Dec.

1986 79 p
(Contract F49620-84-C-0115)
(AD-A177106; SEI-TR-86-13; AFOSR-87-0013TR) Avail: NTIS HC A05/MF A01 CSCL 20/11

This report focuses on the roles of models of flexible structures in the design and evaluation of control laws for the damping of vibrational motions in those structures. The first section discusses a generic class of continuum models for flexible structures describing the abstract mathematical formulation of the models as a framework for the design of control laws. The second section shows how direct frequency domain designs for control laws may be achieved for this class of models based on a spectral factorization procedure which replaces the usual computation of Riccati equations. The third section examines the problem of deriving transfer function representations of the structural models as required in the frequency domain design procedure. Section four describes an analytical procedure for the derivation of continuum models for large scale structures with a regular infrastucture. GRA

N87-21389# Pennsylvania State Univ., University Park. Dept. of Mathematics.
STABILIZATION AND CONTROL PROBLEMS IN STRUCTURAL DYNAMICS Annual Technical Report, 1 Sep. 1985 - 31 Aug. 1986
Goong Chen and Richard H. Herman 15 Oct. 1986 27 p
(Grant AF-AFOSR-0253-85)
(AD-A177183; AFOSR-87-0224TR) Avail: NTIS HC A03/MF A01 CSCL 20/11

Progress on the research of control and stabilization problems in structural dynamics is discussed. Primary emphases was on the modelling, designs, placements and analysis of stabilizers and controllers. Two primary types of vibrating structures were treated: the second order wave equation such as strings and cables, and the fourth order equation such as beams. For those structures, researchers were able to classify the types of stabilizers, analyze their damping behavior, and determine the mechanical designs. Various methods such as characteristics, asymptotic estimation, energy, functional analysis and the Legendre spectral method were used to study the problems. Some relevant theory and methods for general distributed systems and equilibrium problems were developed. GRA

N87-21390# Mound Lab., Miamisburg, Ohio.
MEASUREMENT OF FATIGUE CRACK GROWTH KINETICS OF COPPER-KAPTON LAMINATES BY DYNAMIC MECHANICAL THERMAL ANALYSIS
J. M. Pickard and R. R. Walters 1986 11 p Presented at the 18th Society for the Advancement of Materials and Process Engineering National Technical Conference on Materials, Seattle, Wash., 7 Oct. 1986
(Contract DE-AC04-76DP-00053)
(DE87-003024; MLM-3400(OP); CONF-861004-6) Avail: NTIS HC A02/MF A01

Copper-Kapton laminates fabricated with epoxy and Du Pont WA acrylic adhesives are used in printed circuit applications that are of current interest to the Department of Energy. Kinetics for fatigue crack growth at the Cu-epoxy interface were measured under a helium atmosphere over the temperature range of 473 to 563 K by Dynamic Mechanical Thermal Analysis (DMTA). A least squares treatment of data derived on the basis of a first-order fatigue mechanism resulted in: log (k(T)/s(sup -1)) = (14.6 + or - 0.4) - (175.4 + or - 3.8)/2.303RT, where k(T) is the rate coefficient for thermal fatigue, T is absolute temperature, and R is the ideal gas law constant (R = 0.00831 kJ/K mol). Error estimates for the pre-exponential factor and activation energy correspond to one standard deviation. Arguments are presented which indicate that the upper temperature limit for continuous use of the laminate is 85 C. It is concluded that the laminate will meet and possibly exceed the 27-y shelf life required by the DOE. DOE

N87-21391# Los Alamos National Lab., N. Mex.
GENERAL FINITE STRAIN TENSORS
W. A. Cook Dec. 1986 27 p
(Contract W-7405-eng-36)
(DE87-003807; LA-10715-MS) Avail: NTIS HC A03/MF A01

This report derives, illustrates, and compares general strain tensors (or measures). General strain tensors are a generalization of the Green and Almansi strain tensors that use the reference configuration (or state) to describe the strain tensors as a linear combination of the undeformed and deformed configurations. Two different descriptions (approaches used to describe translation, rotation, and deformation) are used to derive general strain tensors: (1) the corotational, which uses material coordinates to describe the undeformed configuration; spatial coordinates to describe the deformed configuration; and reference coordinates to describe the reference configuration; and (2) the codeformational, which uses convected coordinates to describe the undeformed, deformed, and reference configurations. Because strain tensors have a set of principal axes, along which is an associated stretch (the ratio of differential lengths deformed/undeformed), we were able to use functions of stretch to compare strain measures. We used a uniform extension problem to illustrate the general strain tensors and to compare with other strain measures. DOE

N87-21392# California Univ., Berkeley. Lawrence Berkeley Lab.
ORIGIN OF CRACKING PHENOMENA OBSERVED IN DECOMPOSITION REACTIONS
M. G. Kim, U. Dahmen, and A. W. Searcy Nov. 1986 18 p Presented at the 22nd University Conference on Ceramics. Ceramic Microstructures 86: Role of Interfaces, Berkeley, Calif., 28 Jul. 1986
(Contract DE-AC03-76SF-00098)
(DE87-000199; LBL-22160; CONF-860714-9) Avail: NTIS HC A02/MF A01

The development of cracks in the decomposition of Mg(OH)2 and MgCO3 was observed directly by TEM and SEM. The only identifiable driving force for the cracking is the high excess surface energy of the product solid MgO particles of 2 to 3 nm cube edge. The cracks may form as a consequence of aggregation of these small particles to reduce the excess energy. The decomposition of Mg(OH)2 formed a continuous network of cracks of about 2 microns mesh size while the decomposition of MgCO3 showed the cracks to radiate from isolated centers. This different crack morphology might result from the different orientation variants and the different defect densities of reactant solids. DOE

N87-21393# Oak Ridge Y-12 Plant, Tenn.
ACOUSTIC EMISSION POINT SOURCE LOCATIONS ON THIN SPHERICAL SHELL
O. Burenko and J. Whittaker Jan. 1987 10 p Presented at the Southeastcon 87, Tampa, Fla., 5 Apr. 1987
(Contract DE-AC05-84OS-21400)
(DE87-004015; Y/CSD/INF-86/28; CONF-870478-1) Avail: NTIS HC A02/MF A01

A point source of acoustic emission on a thin spherical shell is defined in spherical and Cartesian coordinates. A required number of acoustic sensors and their locations are postulated for a unique determination of an acoustic emission point source location. Spherical coordinates of an acoustic emission point source are computed using acoustic sensors' measured channel time-differences, radius, and sound propagation velocity in a thin spherical shell. DOE

N87-21394# Sandia National Labs., Albuquerque, N. Mex.
MULTI-POINT TRANSIENT MODAL TESTING
J. P. Lauffer, M. D. Tucker, and D. O. Smallwood 1987 20 p Presented at the 5th International Modal Analysis Conference, London, England, 6 Apr. 1987
(Contract DE-AC04-76DP-00789)
(DE87-003880; SAND-86-2156C; CONF-870446-2) Avail: NTIS HC A02/MF A01

Recent advances in modal testing have made possible the measurement of frequency response functions using multiple uncorrelated random signals. This paper extends these concepts to multiple input transient testing. The theory of multiple input

testing is first extended to allow the use of deterministic inputs, and the conditions for the existence of a solution are examined. It is then shown that the addition of random delays to the inputs will satisfy the conditions for a solution. The technique is then evaluated in an experiment to show the method is a viable experimental technique. DOE

N87-21395# Sandia National Labs., Albuquerque, N. Mex.
IDENTIFICATION OF MATERIAL CONSTANTS FOR A COMPOSITE SHELL STRUCTURE
T. G. Carne and D. R. Martinez Jan. 1987 12 p Presented at the 5th International Modal Analysis Conference, London, England, 6 Apr. 1987
(Contract DE-AC04-76DP-00789)
(DE87-004524; SAND-86-1739C; CONF-870446-3) Avail: NTIS HC A02/MF A01

A finite element model of a composite shell was created. The model includes uncertain orthotropic elastic constants. To identify these constants, a modal survey was performed on an actual shell. The resulting modal data along with the finite element model of the shell were used in a Bayes estimation algorithm. Values of the elastic constants were estimated which minimized the differences between the test results and the finite element predictions. The estimation procedure employed the concept of successive linearization to obtain an approximate solution to the original nonlinear estimation problem. DOE

N87-21396# Ecole Centrale de Lyon (France). Dept. Mathematiques, Informatique, Systemes.
STUDY OF AN OPTIMUM DESIGN PROBLEM WITH FREQUENCY CRITERIA APPLIED TO A STRUCTURE-FLUID COUPLED SYSTEM Ph.D. Thesis [ETUDE D'UN PROBLEME DE CONCEPTION OPTIMALE AVEC CRITERE SUR LES FREQUENCES POUR UN SYSTEME COUPLE FLUIDE-STRUCTURE]
Anne-Claire Deneuvy 1986 214 p In FRENCH Sponsored by the Societe Metravib R.D.S.
(ECL-86-06; ETN-87-99413) Avail: NTIS HC A10/MF A01

A two dimensional mathematical model of the elasto-acoustic behavior of structure-fluid coupled systems was studied in order to develop a computer code to optimize the design of containers or immersed structures. The coupled modes are classified in three groups: structural dominance, acoustical dominance, and strong coupling. The analysis of the numerical results shows that the acoustical parameters are not sensitive to structure thickness variations. The choice of a convergence parameter is shown to play a significant role in the optimization procedure. ESA

N87-21397# Ecole Centrale de Lyon (France). Dept. de Mathematiques, Informatique, Systemes.
PENALIZATION STUDY OF A VARIATIONAL INEQUALITIES SYSTEM USED TO MODEL A CYLINDRICAL SHELL WITH SYMMETRIC LOADING Ph.D. Thesis [ETUDE PAR PENALISATION D'UN SYSTEME D'INEQUATIONS VARIATIONNELLES MODELISANT LE COMPORTEMENT D'UNE COQUE CYLINDRIQUE SOUS CHARGEMENT DE REVOLUTION]
Dzair BouazdiaLakhdari 1986 93 p In FRENCH
(ECL-86-08; ETN-87-99415) Avail: NTIS HC A05/MF A01

The bounded penalization method of Brauner-Nicolaenko is applied to a simple model consisting of a cylindrical shell fixed at one or both ends. The existence of the solution in a given space is proved. The behavior of the system when the displacements are externally limited is studied. A finite element approximation is developed, studying the error estimation and demonstrating the convergence of the method. Numerical examples are presented. ESA

N87-21398# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
FATIGUE CRACK GROWTH UNDER CYCLIC COMPRESSION: ROLE OF FIRST LOAD CYCLE
A. F. Blom, D. K. Holm (Royal Inst. of Tech., Stockholm, Sweden), and S. Suresh (Brown Univ., Providence, R. I.) Nov. 1986 27 p Sponsored by the Swedish Board for Technical Development and DOE
(FFA-TN-1986-71; ETN-87-99446) Avail: NTIS HC A03/MF A01

Crack growth from a notch tip, under the influence of cyclic compression loading is investigated in center cracked specimens of a lower strength steel. Such cracks, caused by the residual tensile deformations at the notch unloading, progressively decelerate until complete arrest occurs. The build up of crack closure during crack advance is considered. The influence of the first underload cycle on the elastic-plastic notch field, crack initiation, crack extension, and crack arrest is examined. Experimental measurements correlate well with numerically obtained estimates of the crack closure loads assuming plane stress conditions. ESA

N87-21399# Technical Research Centre of Finland, Espoo. Lab. of Engineering Production Technology.
MECHANICAL PROPERTIES OF WELDED JOINTS IN TWO FINE-GRAINED STEELS WITH YIELD STRENGTH OF 370 N/mm(SUP)2
Martti Vilpas, Albert Heuser, Helmut Nies, and Risto Karppi Oct. 1986 40 p Sponsored by the German Ministry of Research and Technology, the Finnish Ministry of Trade and Industry, and the Federation of Finnish Metal and Engineering Industries
(VTT-441; ISBN-951-38-2723-2; ISSN-0358-5077; ETN-87-99362)
Avail: NTIS HC A03/MF A01

Weld tests for two microalloyed steels (plate thickness 40 mm): normalized Raex 386 P Arctic (Nb-V) and controlled rolled RR St 52-3U (Ti-N) were carried out using gas metal arc narrow gap, shielded metal arc (SMAW), submerged arc (SAW), and electroslag welding in the arc energy range from 8 to 425 kJ/cm. Results show that the most favorable joint toughness, even superior to that of the base material, is obtained in narrow gap welding (8 kJ/cm). In conventional SMAW and SAW the arc energy has to be reduced below 30 kJ/cm to obtain the most favorable joint toughness. Heat inputs of 40 to 50 kJ/cm are found possible to increase the productivity of SAW when Charpy-V notch 27 J transition temperature of minus 40 to plus 50 C is a sufficient requirement for the joints. The Ti-N steel RR St 52-3U allows higher arc energies to fulfill this toughness level. ESA

N87-21400# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
SELF-ADAPTIVE FINITE ELEMENT (FE) ANALYSIS OF SOLID STRUCTURES. PART 1: ELEMENT FORMULATION AND A POSTERIORI ERROR ESTIMATION
Boerje Andersson, Urban Falk, and Rolf Jarlaas Nov. 1986 64 p
(FFA-TN-1986-27; ETN-87-99443) Avail: NTIS HC A04/MF A01

Three-dimensional problems in linear elastomechanics are considered. A brick-shaped finite element with hierarchical basis functions (p-version) is derived. The element was implemented in a FORTRAN-program STRIPE. An energy error estimator is derived for the element and its accuracy is demonstrated on two and three dimensional model problems where adaptive and nonadaptive solution schemes are used to obtain approximate solutions. ESA

N87-21401# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
FINITE ELEMENT ANALYSIS OF THREE-DIMENSIONAL STRUCTURES USING ADAPTIVE p-EXTENSIONS
Boerje Andersson and Urban Falk Oct. 1986 21 p Presented at NATO Advanced Study Institute on Computer Aided Optimal Design: Structural and Mechanical System, Troia, Portugal, 29 Jun.-11 Jul. 1986
(Contract FMV:FFL-82250-85-076-73-001)
(FFA-TN-1986-57; ETN-87-99445) Avail: NTIS HC A02/MF A01

Linear elastic small displacement and small strain analysis of three-dimensional structures are treated. The p-version of the finite element method is used where basis functions are complete polynomials of order P less than or=12. A FORTRAN-program operative on CRAY-computers is used to analyze three dimensional domains where the exact solutions exhibit singularities at lines and points. The asymptotic rate of convergence observed is

discussed in view of known characteristics of the exact solutions close to corners. Results indicate that the rate of convergence of the finite element solutions is governed by the strength of a line singularity. It is demonstrated that solutions obtained using adaptively constructed p-extensions lead to a high rate of convergence in the energy norm compared to strategies where uniform h, or p-extensions are used. ESA

N87-21402# Rome Univ. (Italy). Dipt. di Fisica.
FLUCTUATIONS IN MEMBRANES WITH CRYSTALLINE AND HEXATIC ORDER
D. R. Nelson (Harvard Univ., Cambridge, Mass.) and L. Peliti 15 Jan. 1987 22 p Submitted for publication
(Grant NSF DMR-85-14638)
(Preprint-538; ETN-87-99753) Avail: NTIS HC A02/MF A01

The interplay between crystalline (or hexatic) order and thermal fluctuations in membranes with vanishing surface tension is studied. If the connectivity of the crystalline state is preserved, the membrane remains uncrumpled at low temperatures. When dislocations are allowed, however, screening of elastic stresses by buckling leads to a dilute concentration of unbound dislocations at all nonzero temperatures. When the resulting hexatic phase is stable, the stiffness associated with orientational correlations leads to a logarithmic enhancement of the bending rigidity which counteracts the thermal softening found in fluid surfaces. Finite temperature crumpling transitions appear to be possible in crystalline and hexatic membranes. ESA

N87-21197# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
VIBRATION ANALYSIS BY SPECKLE INTERFEROMETRY
Hartwig Knoell *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 9 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

42 GEOSCIENCES (GENERAL)

N87-21403# National Oceanic and Atmospheric Administration, Princeton, N.J. Geophysical Fluid Dynamics Lab.
GEOPHYSICAL FLUID DYNAMICS LABORATORY ACTIVITIES FY86, PLANS FY87
Sep. 1986 184 p
(PB87-134458) Avail: NTIS HC A09/MF A01 CSCL 08E

The contents of the Geophysical Fluid Dynamics Laboratory Activities (FY 86) and Plans (FY 87) are as follows: Climate dynamics; Middle atmosphere dynamics and chemistry; Experimental prediction; Oceanic circulation; Planetary circulation; Observational studies; Hurricane dynamics; Mesoscale dynamics; and Convection and turbulence. GRA

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N87-21404# Georgia Inst. of Tech., Atlanta.
RETRIEVAL OF MOVING WAVES FROM POLAR ORBITING SATELLITE DATA Ph.D. Thesis
Chowen Chou Wey 1986 113 p
Avail: Univ. Microfilms Order No. DA8622465

The asynoptic nature of orbiting satellite data has presented difficulty in its interpolation. The estimation procedures developed by Kalman and Bucy provide a framework for obtaining an optimal estimate at any given time of the atmospheric field being measured. In the past, these procedures have incorporated atmospheric models consisting of stationary waves. The development and testing of a moving wave model (in which wave growth rate and phase speed are estimated in addition to wave amplitude and phase) is described. The moving wave model assumes wave growth rate and phase speed are constant over a period of a few days. It uses the stationary wave model solution as the a priori information for linearizing the model equations. Simulated data sets, ranging from stationary waves to non-constant growing and moving waves, are used to test the algorithm. The potential of the improvement of solutions by iteration is tested and found unnecessary in most cases. Dissert. Abstr.

N87-21405# Royal Aircraft Establishment, Farnborough (England).
REGIS: AN RAE EXPERIMENTAL IMAGE-BASED GEOGRAPHIC INFORMATION SYSTEM
J. M. Williams Nov. 1984 41 p Original contains color illustrations
(RAE-TR-84103; RAE-Space-640; BR99068; ETN-87-99467) Avail: NTIS HC A03/MF A01

The REGIS image-based geographic information system to combine remotely-sensed images with digital map data is described. How the information is stored as digital images, how the GEMS system is used to manipulate and display these images, and how various forms of output are produced are described. Examples of the wide scope of REGIS, including a worked answer to a typical problem are given. The hardware, the processes used to convert the data to image format, and the more advanced uses of REGIS are summarized. ESA

N87-21406# Washington Univ., St. Louis, Mo. Dept. of Computer Science.
RAPID SEARCH FOR SPHERICAL OBJECTS IN AERIAL PHOTOGRAPHS
Kenneth Cox, Gruia-Catalin Roman, and William Ball Jul. 1986 15 p
(Contract DMA800-85-C-0010)
(AD-A176391; WUCS-86-15) Avail: NTIS HC A02/MF A01 CSCL 14/5

This paper describes a method for detecting and segmenting spherical features using the gradient angle for ideal spheres with a discussion of how this may be used to locate the boundaries of the sphere. The algorithms used by a program which detects and segments spherical features are then presented. The results of applying the program to images with naturally-occuring spherical features are given. GRA

N87-21407# Inter-American Geodetic Survey, APO Miami, Fla.
THE UNIVERSAL TRANSVERSE MERCATOR GRID FORMULAS FOR CARTOGRAPHIC APPLICATIONS PROGRAMMERS
Liam P. OBrien 31 Jul. 1986 21 p
(AD-A176624) Avail: NTIS HC A02/MF A01 CSCL 08/2

Cartographers frequently need to transform geographic coordinates, via a projection system, to their corresponding rectangular coordinates. The traditional method of using look up tables is no longer efficient. We now can use hand held microcomputers and programmable calculators to do the coordinate transformations. A problem has been the difficulty in locating concise, easy to program transformation formulas. This paper presents easy to program formulas to the Universal Transverse Mercator Grid (UTM grid). The paper begins with a short history of the development of the UTM grid system and then states its basic characteristics. Following this the forward and inverse transformation formulas are presented. The last section contains two features of aid to the programmer. These are sample programs, written in BASIC and numerical examples. GRA

N87-21408# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
FOUNDATIONS AND APPLICATIONS OF MULTISPECTRAL SCANNING IN AGRICULTURE
N. J. J. Bunnik 5 Feb. 1985 46 p In DUTCH; ENGLISH summary

Presented at the Royal Society for Physics Diligentia, The Netherlands, 5 Nov. 1985
(NLR-MP-85015-U; ETN-87-99283) Avail: NTIS HC A03/MF A01

Remote sensing techniques in the visible and near IR ranges for crop yield forecasting and crop disease identification are treated. The interaction of crops and soils with short wave radiation in the optical spectrum is discussed in order to derive the necessary information regarding the spectral distribution of reflected sunlight. The modeling of vegetation canopies is described in relation to yield measurement techniques. The operating principles of multispectral scanning are given, together with examples. ESA

N87-21409# Marconi Space Systems Ltd., Portsmouth (England).
TESTING OF THE ADVANCED MICROWAVE INSTRUMENT FOR THE EUROPEAN REMOTE SENSING SATELLITE ERS-1 M.S. Thesis - Surrey Univ., Guildford, England
R. Lowther Sep. 1986 111 p
(ETN-87-99477) Avail: NTIS HC A06/MF A01

The instrumentation, operation, and testing of the Active Microwave Instrument (AMI) for ERS-1 are described. Methods devised for the prelaunch testing of the AMI and in particular measurements of the calibration loop stability are discussed. The latter uses a method of monitoring changes in relative pulse amplitudes by sensitive spectral lines in the frequency spectrum, rather than time waveforms. The limitations to the technique lie mainly in the noise constraints of the system. The noise level limits which spectral lines can be used and those excluded are mainly the more sensitive lines. These limits do not invalidate the technique in case of ERS-1 but noise does impinge upon the measurements. Ideally, it requires a signal-to-noise greater than 24 dB which would limit 3 dB noise fluctuations to less than 0.02 dB and more lines would then be useful. ESA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N87-21410* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BIDIRECTIONAL CONTROL SYSTEM FOR ENERGY FLOW IN SOLAR POWERED FLYWHEEL Patent
Frank J. Nola, inventor (to NASA) Issued 10 Mar. 1987 8 p Filed 31 Jul. 1984 Supersedes N84-32913 (22 - 22, p 3616)
(NASA-Case-MFS-25978-1; US-Patent-4,649,287; US-Patent-Appl-SN-636459; US-Patent-Class-307-31; US-Patent-Class-307-131; US-Patent-Class-307-64; US-Patent-Class-307-66; US-Patent-Class-307-80; US-Patent-Class-318-107; US-Patent-Class-318-161) Avail: US Patent and Trademark Office CSCL 10A

An energy storage system for a spacecraft is provided which employs a solar powered flywheel arrangement including a motor/generator which, in different operating modes, drives the flywheel and is driven thereby. A control circuit, including a threshold comparator, senses the output of a solar energy converter, and when a threshold voltage is exceeded thereby indicating the availability of solar power for the spacecraft loads, activates a speed control loop including the motor/generator so as to accelerate the flywheel to a constant speed and thereby store mechanical energy, while also supplying energy from the solar converter to the loads. Under circumstances where solar energy is not available and thus the threshold voltage is not exceeded, the control circuit deactivates the speed control loop and activates a voltage control loop that provides for operation of the motor as a generator so that mechanical energy from the flywheel is converted into electrical energy for supply to the spacecraft loads.
Official Gazette of the U.S. Patent and Trademark Office

N87-21411*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HIGH EFFICIENCY CRYSTALLINE SILICON SOLAR CELLS Final Technical Report
C. Tang Sah 15 Jun. 1986 87 p Sponsored in part by DOE (Contract JPL-956289)
(NASA-CR-180530; JPL-9950-1234; DOE/JPL-956289-86/1; NAS 1.26:180530; TR-3) Avail: NTIS HC A05/MF A01 CSCL 10A

A review of the entire research program since its inception ten years ago is given. The initial effort focused on the effects of impurities on the efficiency of silicon solar cells to provide figures of maximum allowable impurity density for efficiencies up to about 16 to 17%. Highly accurate experimental techniques were extended to characterize the recombination properties of the residual imputities in the silicon solar cell. A numerical simulator of the solar cell was also developed, using the Circuit Technique for Semiconductor Analysis. Recent effort focused on the delineation of the material and device parameters which limited the silicon efficiency to below 20% and on an investigation of cell designs to break the 20% barrier. Designs of the cell device structure and geometry can further reduce recombination losses as well as the sensitivity and criticalness of the fabrication technology required to exceed 20%. Further research is needed on the fundamental characterization of the carrier recombination properties at the chemical impurity and physical defect centers. It is shown that only single crystalline silicon cell technology can be successful in attaining efficiencies greater than 20%. Author

N87-21412*# Mobil Tyco Solar Energy Corp., Waltham, Mass.
STRESS AND EFFICIENCY STUDIES IN EFG Final Report, 9 Jul. 1982 - 15 Jul. 1986
15 Jul. 1986 82 p Sponsored in part by DOE (Contract JPL-956312)
(NASA-CR-180527; JPL-9950-1249; DOE/JPL-956312/15; NAS 1.26:180527) Avail: NTIS HC A05/MF A01 CSCL 10A

The goals of this program were: (1) to define minimum stress configurations for silicon sheet growth at high speeds; (2) to quantify dislocation electrical activity and their limits on minority carrier diffusion length in deformed silicon; and (3) to study reasons for degradation of lifetime with increases in doping level in edge-defined film-fed growth (EFG) materials. A finite element model was developed for calculating residual stress with plastic deformation. A finite element model was verified for EFG control variable relationships to temperature field of the sheet to permit prediction of profiles and stresses encountered in EFG systems. A residual stress measurement technique was developed for finite size EFG material blanks using shadow Moire interferometry. Transient creep response of silicon was investigated in the temperature range between 800 and 1400 C in strain and strain regimes of interest in stress analysis of sheet growth. Quantitative relationships were established between minority carrier diffusion length and dislocation densities using Electron Beam Induced Current (EBIC) measurement in FZ silicon deformed in four point bending tests. Author

N87-21413*# ARCO Solar, Inc., Chatsworth, Calif.
PULSED EXCIMER LASER PROCESSING FOR COST-EFFECTIVE SOLAR CELLS Final Report, May 1984 - Dec. 1985
David C. Wong Dec. 1985 143 p Sponsored in part by DOE (Contract JPL-956831)
(NASA-CR-180528; DOE/JPL-956831-81/1; JPL-9950-1232; NAS 1.26:180528; DRL-216; DRD-SE-4; FR-1) Avail: NTIS HC A07/MF A01 CSCL 10A

The application of excimer laser in the fabrication of photovoltaic devices was investigated extensively. Processes included junction formation, laser assisted chemical vapor deposition metallization, and laser assisted chemical vapor deposition surface passivation. Results demonstrated that implementation of junction formation by laser annealing in production is feasible because of excellent control in junction depth and quality. Both metallization

and surface passivation, however, were found impractical to be considered for manufacturing at this stage. Author

N87-21414# Energy Research Corp., Danbury, Conn.
CORROSION RESISTANT MATERIALS IN MCFC ENVIRONMENT Final Report, Oct. 1984 - Sep. 1986
A. Pigeaud, C. Y. Yuh, and P. Singh 1986 145 p
(Contract DE-AC21-84MC-21186)
(DE87-004199; DOE/MC-21186/2260) Avail: NTIS MF A01

A 24-month effort in the development of a corrosion resistant hardware material for molten carbonate fuel cell (MFC) application is described. The objective was to identify an inexpensive alloy for MCFC current collector/bipolar plate application. For this, 310S was selected as the base alloy composition and La, Ce and Si were added to improve corrosion resistance. Eight candidate alloys, including 310S and 316L, were screened in MCFC anode and cathode atmospheres. The techniques used include isothermal corrosion, acoustic emission, thermal cycling corrosion, thermogravimetric analyses, electrical surface resistance, and dual atmosphere corrosion testing. Oxide scales formed were analyzed by standard metallographic techniques. The results indicate that COLT-25+ and Crutemp-25 alloys (both containing 25Cr-25Ni and balance Fe) have the best corrosion resistance in the MCFC environment. Rare earth additives, La and Ce, do not appear to improve isothermal or thermal cycling resistance. Silicon addition appears to improve thermal cycling but not isothermal corrosion resistance. High Mn content (approx. 18%) appears detrimental based on this limited investigation. Currently used 316L has the least corrosion resistance of all the alloys tested. Pressurized tests have shown that high pressure (10 atm) reduces corrosion rate in the anode atmosphere whereas it only slightly affects corrosion rate in the cathode atmosphere. DOE

N87-21415# Oak Ridge National Lab., Tenn.
METAL HYDRIDE TEMPERATURE AMPLIFIERS FOR HIGH TEMPERATURE (>260 C) APPLICATIONS: A PARAMETRIC STUDY Final Report
M. R. Ally Dec. 1986 48 p
(Contract DE-AC05-84OR-21400)
(DE87-005297; ORNL/TM-10166) Avail: NTIS HC A03/MF A01

The viability of hydriding alloys as working media in heat pumps to achieve temperature boosts up to 260 C or better is investigated on the basis of the mass transfer zone concept of absorption bed design and a return on capital investment of two years. The Van't Hoff curves of various metals in the temperature and pressure ranges of interest were found in the open literature. An integrated form of the Clausius-Clapeyron equation was used to describe the equilibrium hydrogen pressure temperature relationship. Design equations pertaining to overall material and heat balances are presented. An assumption in the development of these equations is that of steady state operation. Other, more stringent assumptions pertain to cycling stability, resistance to poisoning, constant absorption capacity and durability of the metal over a two year period. The design equations along with the necessary thermodynamic data are incorporated in an interactive FORTRAN computer program called HYDRIDE which determines the quantity of metal required per bed for an 8.79 x 10 W (30 x 10 Btu/h) temperature amplifier. The computer results show that even under the optimistic assumptions of the model, the estimated metal required per bed would be between 15,900 and 22,700 kg, depending on the particular metals chosen. Based on a metal cost of $33.07/kg and cost of energy at $5/10 Btu, the maximum permissible metal in each bed for a two year payback works out to be 4535 kg. It is therefore concluded that even under very optimistic conditions, hydriding alloys is economically unattractive for heat pump applications. DOE

N87-21416# Purdue Univ., West Lafayette, Ind. School of Electrical Engineering.
COMPUTER MODELING OF HIGH INTENSITY SOLAR CELLS
J. L. Gray, M. S. Lundstrom, and R. J. Schwartz Jan. 1987 112 p Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE87-005970; SAND-86-7048) Avail: NTIS HC A06/MF A01

The purpose of this program is to provide general analytic support to Sandia National Laboratories' effort to develop high efficiency, high concentration solar cells. This report covers work performed between November 5, 1984, and December 31, 1985, and includes reprints of three papers presented at the 18th IEEE Photovoltaic Specialists' Conference. In the first paper, the factors that presently prevent achieving the predicted theoretical efficiencies (in excess of 30% at concentration) are examined. It is demonstrated, by two-dimensional computer simulations, that these efficiencies might be obtained by improved light trapping techniques and by fabrication of low resistance heteroface contacts. The second paper examines the Rose-Weaver lifetime and surface recombination velocity measurement technique. It is shown that the very small uncertainties in the measured quantities lead to large uncertainties in the computed lifetime and surface recombination velocity. This leads to radically different interpretations of how the recombination is distributed throughout the device, and therefore limits the usefulness of the measurement technique. Design options and constraints of GaAs concentrator cells are examined in the third paper. The effectiveness of various design options is assessed. It is shown that although such design options are of little use in increasing the efficiency of heteroface cells, they can improve the efficiency of shallow junction cells so that it is comparable to that of heteroface cells. In addition, documentation describing the use of both the one- and two-dimensional silicon codes, SCAP1D and SCAP2D, as well as the one-dimensional AlGaAs solar cell simulation code is included. DOE

N87-21417*# Westinghouse Research and Development Center, Pittsburgh, Pa.
LARGE AREA SHEET TASK: ADVANCED DENDRITIC WEB GROWTH DEVELOPMENT Final Report, May 1985 - Sep. 1986
1986 318 p Sponsored in part by DOE
(Contract NAS-7-100)
(NASA-CR-180505; NAS 1.26:180505; DE87-005961; DOE/JPL-957207-86-1) Avail: NTIS MF A01 CSCL 10A

Progress is reported in the areas of thermal modeling and analysis of dendritic web growth, elastic stress analysis, plastic flow analysis, control of melt convection for improved growth stability, web growth studies, web characterization, melt replenishment and closed loop control. A dendritic web growth cost analysis is also presented. Basic experimental studies were carried out on four development furnaces, and seven separate pilot furnaces were used to explore long term behavior and to collect statistical information. Increases in area growth rate are reported. It is concluded from the model analyses and experimental measurements that high speed ribbons can be grown with low residual stress and high cell efficiency. The original analog laser melt level control was replaced by a digital system which enhances the signal to noise ratio of the level sensor and reduces fluctuations in the pellet feed rate. Closed loop growth control was demonstrated. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N87-21418# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
ATMOSPHERIC TRANSPORT AND DISPERSION OF POLLUTANTS AND RELATED METEOROLOGICAL STUDIES: PROGRAM SUMMARY
J. L. Heffter, R. R. Draxler, B. J.B. Stunder, C. K. Stieneke, and C. A. Burr Sep. 1986 27 p
(Contract DE-AI05-83ER-60113)
(DE87-005644; DOE/ER-60113/3) Avail: NTIS HC A03/MF A01

The adverse effects of air pollutants on man and the environment during their long-range transport and dispersion continue to

be of major concern (e.g., acid rain, arctic haze, accidental pollutant releases). Air pollution models have been developed to simulate atmospheric and chemical processes out to distances of several thousand kilometers from pollutants sources. Verification of these model calculations continues to be of major importance in our efforts to establish the uncertainty associated with model simulations. DOE

N87-21419# Netherlands Energy Research Foundation, Petten.
EFFECTIVE REMOVAL PARAMETERS IN LONG-RANGE TRANSPORT MODELS, DERIVED FROM DIFFUSION THEORY CALCULATIONS
A. J. Janssen and W. A. H. Asman (Utrecht State Univ., Netherlands) Sep. 1986 33 p
(ECN-187; IMOU-R-86-15; B8678614; ETN-87-99605) Avail: NTIS HC A03/MF A01

It is shown how the necessary correction factors can be put into a simple Lagrangian air pollution transport model and how a reactive diffusion model is used to derive the values of these factors. Calculated values are given for the pollutants NH3, SO2 and NOx and for their reaction products NH4(+) SO4(2-) and NO3(-) respectively. Sensitivity calculations are made and results are compared with the results of other diffusion models. Results show that the correction factors are very important for ground level sources of pollutants with relatively high dry deposition velocities, such as NH3. The factors depend on meteorological conditions and have therefore an inherent uncertainty. However, by applying the correction factors in simple long-range transport models a substantial improvement is obtained in calculated ground level concentrations and deposition patterns. Results are as good as those of more sophisticated models which require much more computing time. ESA

N87-21420# National Oceanic and Atmospheric Administration, Washington, D. C.
REPORT TO THE CONGRESS ON OCEAN POLLUTION, MONITORING AND RESEARCH, OCTOBER 1984 THROUGH SEPTEMBER 1985
May 1986 80 p
(PB87-129425) Avail: NTIS HC A05/MF A01 CSCL 13B

Under Section 201 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, the Congress assigned to the Department of Commerce the responsibility to monitor and research the effects of dumping wastes into the ocean. The ocean pollution activities carried out by the National Oceanic and Atmospheric Administration during the fiscal year 1985 are described. The results are described from a comprehensive, continuing program of assessment, including research, development, and monitoring, on the short- and long-term effects of human activities on the marine environment. Author

N87-21421# Science Applications International Corp., McLean, Va.
HANDBOOK FOR USING FOAMS TO CONTROL VAPORS FROM HAZARDOUS SPILLS Report, Apr. 1984 - Sep. 1985
M. L. Evans and H. A. Carroll Jul. 1986 36 p
(Contract EPA-68-03-3113)
(PB87-145660; EPA-600/8-86-019) Avail: NTIS HC A03/MF A01 CSCL 13B

The handbook describes basic types of foams that may be used to control vapor hazards from spilled volatile chemicals. It provides a table to be used by spill response personnel to choose an appropriate foam based on the type of chemical spill. Six general types of foams, surfactant (syndet) foams, aqueous film forming foams (AFFF), alcohol type or polar solvent type foams (ATF), and special foams such as Hazmat NF no. 1 which was developed especially for alkaline spills. The handbook provides the basis for spill responders to evaluate and select a foam for vapor control by using the test methods presented or by considering manufacturers specifications for foam expansion ratios and quarter drainage times. The responder is encouraged to maximize the effectiveness of a foam by trying different nozzles, distances of applications, and thicknesses of the foam layers. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N87-21422 Princeton Univ., N. J.
EVALUATION OF SATELLITE SAMPLING OF THE MIDDLE ATMOSPHERE USING THE GFDL SKYHI GENERAL CIRCULATION MODEL Ph.D. Thesis
Denise Stephenson Graves 1986 329 p
Avail: Univ. Microfilms Order No. DA8624314

Research has been performed to quantify differences between meteorological diagnostics defined from measurements of satellite radiance and those defined from a four-dimensional verification data set, NOAA's Geophysical Fluid Dynamics Laboratory's SKYHI general circulation model (GCM). A complete simulation of the calculation of vertical temperature profiles from asynoptic, nadir-viewing, polar orbiting satellite data was performed. Channel radiances for the High Resolution Infrared Sounder (HIRS-2), the Stratospheric Sounding Unit (SSU) and the Microwave Sounding Unit (MSU) instruments which composes the Tiros-N Operational Vertical Sounder were defined for the SKYHI atmosphere. These radiances were then used to calculate vertical temperature profiles using the technique of statistical linear regression analysis. Computer codes modeling this mathematical technique as well as the definition of channel radiances were supplied by NOAA/NESDIS in Suitland, Maryland. NOAA/NESDIS currently uses these programs in an operational mode to process measurements of atmospheric radiance obtained via the satellite platform. Dissert. Abstr.

N87-21423# Florida State Univ., Tallahassee.
RETRIEVALS OF LOWER STRATOSPHERIC OZONE PROFILES FROM NIMBUS-4 AND THEIR USE IN A SYNOPTIC-CLIMATOLOGICAL STUDY Ph.D. Thesis
Ronald Mitsud Nagatani 1986 158 p
Avail: Univ. Microfilms Order No. DA8625788

Radiation data from the Backscatter Ultraviolet (BUV) instrument on Nimbus 4, although designed for retrieval of total ozone and ozone profiles above the ozone maximum, were used in an empirical method to extrapolate ozone profiles to the lower stratosphere. Ozone data and radiation data were first decomposed into eigenvectors and associated coefficients. Since the coefficients are orthogonal to each other, they form linearly independent data sets which were regressed in a least squares manner forming a basis from which retrievals were obtained. After the retrieved profiles were found to correlate with observed profiles, a year of retrieved data was analyzed to yield daily synoptic maps. A synoptic-climatological study was done using the maps, focusing on the winter of 1970 to 1971 for the synoptic study. The climatological study encompassed the full year of analyzed maps. A figure of 50 metric tons per second of vertically integrated fluxes by the eddies across a latitude circle at high latitudes during the winter corresponds to observational and numerical studies. Dissert. Abstr.

N87-21424 Colorado State Univ., Fort Collins.
CONVECTIVE SCALE INTERACTION: ARC CLOUD LINES AND THE DEVELOPMENT AND EVOLUTION OF DEEP CONVECTION Ph.D. Thesis
James Francis Whitehurst Purdom 1986 218 p
Avail: Univ. Microfilms Order No. DA8625113

Information from satellite data and research aircraft data are used to provide new understanding concerning the mesoscale development and evolution of deep convection in an atmosphere typified by weak synoptic-scale forcing. The major topic covered

is the importance of convective scale interaction in the development and evolution of deep convection. This interaction is shown to manifest itself as the merger and intersection of thunderstorm outflow boundaries (arc cloud lines) with other convective lines, areas or boundaries. Using geostationary satellite visible and infrared data, convective scale interaction is shown to be responsible for over 85% of the intense convection (colder than -42 C) over the southeast United States by late afternoon (6 pm local), and an overwhelming majority of that area's afternoon rainfall. Using satellite image and sounding data, as well as research aircraft information, it is shown how variations in a local environment's ability to support strong convection may be determined. Using this information, coupled with information about the arc cloud line's life cycle, distinct properties of convective scale interaction are analyzed. Dissert. Abstr.

N87-21425 Colorado State Univ., Fort Collins.
A NUMERICAL INVESTIGATION OF AN OROGENIC MESOSCALE CONVECTIVE SYSTEM Ph.D. Thesis
Gregory John Tripoli 1986 301 p
Avail: Univ. Microfilms Order No. DA8625118

The interaction of topographically induced thermally and mechanically driven diurnal flow regimes in the lee of the Rockies is shown to lead to the growth of a mesoscale convective system (MCS). The findings are based on a series of two-dimensional and three-dimensional non-hydrostatic numerical simulations of an intensively-studied convective event that occurred during the 1977 SPACE (South Park Area Cumulus Experiment)/HIPLEX (High Plains Experiment). The results suggest a multi-scale interaction leading to the formation of a quasi-geostrophically balanced warm core deep circulation system on the scale of the Rossby Radius. The genesis is initiated by the formation of deep cumuli in association with mountain wave and slope flows. The simultaneous maintenance of a thermal boundary layer capping inversion over the High Plains to the east keeps the convection localized and therefore leads to a systematic balanced atmospheric response over a period of 12 hours. The convective core itself is organized on the meso-beta scale and is transient in nature. Because favorable conditions for deep convection are localized by the plains inversion, convection does not move with the meso-beta pulses emitted and instead reforms continually as the vertical motion oscillates. The meso-alpha scale system moves eastward with a speed near the mean tropospheric wind. Dissert. Abstr.

N87-21426# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
OPERATIONS HANDBOOK-OZONE MEASUREMENTS TO 40-KM ALTITUDE WITH MODEL 4A ELECTROCHEMICAL CONCENTRATION CELL (ECC) OZONESONAES (USED WITH 1680-MHz RADIOSONDES)
W. D. Komhyr Sep. 1986 58 p
(PB87-113874; NOAA-TM-ERL-ARL-149) Avail: NTIS HC A04/MF A01 CSCL 04A

Electrochemical concentration cell (ECC) ozone-sondes are flown by balloon at a number of stations throughout the world to obtain data on atmospheric ozone vertical distributions to near 40 km altitude. The handbook gives information about the instrumentation (including the balloon vehicles), and provides instructions concerning preparation of the instruments for flight, data reduction, and data archiving. The instructions are intended to standarize operation of the instruments so that different users might obtain data of comparable quality. GRA

N87-21427*# Texas Univ., Dallas. Center for Space Sciences.
RETARDING POTENTIAL ANALYZER RESEARCH Semiannual Report, 1 Jul. - 31 Dec. 1986
W. B. Hanson 24 Apr. 1987 9 p
(Grant NAG5-305)
(NASA-CR-180508; NAS 1.26:180508) Avail: NTIS HC A02/MF A01 CSCL 04A

Studies were continued in the areas of ionospheric electrodynamics, plasma irregularities, and ion-neutral coupling. The spectral characteristics of structure in the ion concentration and the electric field at high latitudes were examined. It was found that in the region of velocity shears the relationship between the slopes of the two spectra are dependent on the existence of large field-aligned currents and apparently large ionospheric conductivity gradients. The relationship between the Joule dissipation and the locally measured value of the ion temperature were studied by examining the horizontal ion drift velocity. The importance of ion-neutral coupling was investigated in additional studies involving the nature of the coupling at high latitude boundaries and during times of magnetic disturbances. Much of this behavior can be modeled using globular circulation models. In order to study the storm time response of the thermosphere the global ion convection pattern was derived from DE-2 measurements and used as input in a circulation model. The calculated variables of neutral velocity and composition and temperature were compared with measurements to validate the technique. B.G.

N87-21428*# Massachusetts Inst. of Tech., Cambridge.
THREE DIMENSIONAL DYNAMICAL AND CHEMICAL MODELLING OF THE UPPER ATMOSPHERE Final Technical Report
Ronald G. Prinn, Fred N. Alyea (Georgia Inst. of Tech., Atlanta), and Derek M. Cunnold Jul. 1985 99 p
(Grant NsG-2010)
(NASA-CR-180514; NAS 1.26:180514) Avail: NTIS HC A05/MF A01 CSCL 04A

Improved versions of a global 3-dimensional dynamical-chemical model of the stratospheric ozone layer were developed and utilized. The major accomplishments are described. B.G.

N87-21429*# Institute for Atmospheric Optics and Remote Sensing, Hampton, Va.
VALIDATION OF SAM 2 AND SAGE SATELLITE Final Report
G. S. Kent, P.-H. Wang, U. O. Farrukh, and G. K. Yue Apr. 1987 146 p
(Contract NAS1-17032)
(NASA-CR-178256; NAS 1.26:178256; IFAORS-TR-248) Avail: NTIS HC A07/MF A01 CSCL 04A

Presented are the results of a validation study of data obtained by the Stratospheric Aerosol and Gas Experiment I (SAGE I) and Stratospheric Aerosol Measurement II (SAM II) satellite experiments. The study includes the entire SAGE I data set (February 1979 - November 1981) and the first four and one-half years of SAM II data (October 1978 - February 1983). These data sets have been validated by their use in the analysis of dynamical, physical and chemical processes in the stratosphere. They have been compared with other existing data sets and the SAGE I and SAM II data sets intercompared where possible. The study has shown the data to be of great value in the study of the climatological behavior of stratospheric aerosols and ozone. Several scientific publications and user-oriented data summaries have appeared as a result of the work carried out under this contract. Author

N87-21430# Physical Dynamics, Inc., Bellvue, Wash.
DEVELOPMENT OF TECHNIQUES FOR THE USE OF DMSP (DEFENSE METEOROLOGY SATELLITE PROGRAM) SSIE (TOPSIDE IONOSPHERIC PLASMA MONITOR) DATA IN THE AWS (AIR WEATHER SERVICE) 4D IONOSPHERE MODEL Final Report, 1 Jul. 1984 - 20 Apr. 1985
James A. Secan 20 Apr. 1985 101 p
(Contract F19628-83-C-0106)
(AD-A176412; PD-NW-85-327R-1; AFGL-TR-85-0107-1) Avail: NTIS HC A06/MF A01 CSCL 04/1

Techniques for improved use of topside ionosphere observations within the Air Weather Service 4D ionosphere model system are investigated. Topside observations are available at the Air Force Global Weather Center from the Topside Ionospheric Plasma Monitor (SSIE) on the Block 5D DMSP satellites. The investigations cover three study areas: (1) improvements to the topside ionospheric electron density profile model used within the 4D model; (2) improvements to the ionospheric data preprocessors in the 4D model system; and (3) improvements to the 4D model. Results are presented for tasks completed during the second year of the project. A parameterization of the topside electron density profile

was developed based on a two component diffusive equilibrium representation of the ionosphere. This topside model can use the entire data set from the SSIE sensor to specify the profile or, if some data are unavailable, it will use an empirical model of the height O(+) to H(+) transition height to construct the profile. A method was developed for generating grids of the 840km electron density from observations along an orbit track, and a computer program was written to test the method. This program was also used to investigate joint analyses of N sub e (840) and Total Electron Content observations. Author

N87-21431# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
THE REPRESENTATION OF THE EARTH'S GRAVITATIONAL POTENTIAL IN A SPHERICAL HARMONIC EXPANSION TO DEGREE 250
Richard H. Rapp and Jaime Y. Cruz Sep. 1986 71 p
(Contract F19628-86-K-0016)
(AD-A176479; OSU/DGSS-372; AFGL-TR-86-0191) Avail: NTIS HC A04/MF A01 CSCL 08/5

Earth's geopotential is presented in a spherical harmonic series that is complete to degree and order 250. This solution is obtained by carrying out a combination of satellite derived potential coefficients (GEML2') with a set of 1 deg by 1 deg mean free air anomalies. The latter are formed from a merger of a June 1986 terrestrial set and a set derived from GEOS-3/SEASAT altimeter data. The combination solution was carried out after making downward continuation corrections to the surface anomalies and ellipsoidal corrections to the a priori potential coefficients. The adjustment yielded 582 potential coefficients and 64800 1 deg by 1 deg anomalies. Two combination solutions were made, one (OSU86C) excluding geophysically predicted anomalies and one (OSU86D) including 5547 such anomalies. The potential coefficients are determined through an optimal estimation procedure where, primarily, sampling error was minimized. Tests of the new solution were made by comparing undulation residuals at Doppler stations, and by using the field, up to deg 36, in orbit calculations. In North America the RMS undulation difference was + or - 1.55 m. The undulation residuals are found to correlate with elevation although it is not clear why. GRA

N87-21432# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
MULTISPECTRAL ANALYSIS OF A TROPICAL RADIANCE SET FROM THE TIROS OPERATIONAL VERTICAL SOUNDER Ph.D. Thesis
Lloyd L. Anderson, Jr. Dec. 1986 247 p
(AD-A176576; AFIT/CI/NR-87-26D) Avail: NTIS HC A11/MF A01 CSCL 04/2

The information content of the TIROS-N Operational Vertical Sounder (TOVS) during 20-29 Jan 1979 over the tropical Pacific Ocean is examined. Vertical, horizontal, and temporal statistical characteristics are also examined. The TOVS channels are highly correlated except for the infrared water vapor channels and the microwave window and 300 mb channels. The horizontal structure varies according to spectral channel (absorbing constituent and effective evaluation), geography, and synoptic condition. Horizontal correlation is particularly sensitive to water vapor and cloud amount. In equatorial sectors, moisture channels have higher correlations and larger length scales than thermal sensing channels; in the subtropics, the opposite is true. Temporal variation is largest in the water vapor and microwave window channels, and in synoptically active regions with brightness temperature variances typically ten times larger than in synoptically quiescent regions. Attempts to augment TOVS data in cloudy regions and for missing passes using a full quadratic response surface regression model were only marginally successful. TVOS channels with peak energy contribution from below 90 mb were synthesized using principal components analysis. Over 94% of the areal variance at any particular time is represented by the first 5 eigenfunctions. GRA

N87-21433# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
AN ANALYSIS OF UPPER ATMOSPHERIC PARAMETERS DERIVED FROM THE OBSERVATION OF METEOR ECHOES BY A 2.66 MHz RADAR M.S. Thesis
Robert S. Turek 1986 82 p
(AD-A176662; AFIT/CI/NR-87-3T) Avail: NTIS HC A05/MF A01 CSCL 17/9

The Imaging Middle-Atmosphere Geophysical Radar (IMAGER) is operated at a frequency of 2.66 MHz and was used to collect data at the Boot Lake, Colorado, field site. It was desired to study the feasibility of meteor echo analysis using this medium frequency (MF) radar system, as very few meteor studies had been carried out at this relatively low radar frequency. An algorithm was developed that separated the returns attributed to meteors from the remainder of the data. The meteor detection rate for the period of observation was approximately 58 meteors per hour. The meteor echoes were located in three-dimensional space and the u, v, and w wind components were then calculated from the Doppler shift of the meteor echoes. The remainder of the data was subjected to the Imaging Doppler Interferometer (IDI) wind analysis technique, with subsequent comparison between the three component-wind values obtained from the two methods. The two wind analysis techniques showed good agreement, with root-mean-square (rms) values for the horizontal and vertical winds being on the order of 30 m/s and 2 m/s, respectively. GRA

N87-21434# Alaska Univ., Fairbanks. Geophysical Inst.
ANTARCTIC ATMOSPHERIC INFRASOUND Final Technical Report, 1 Jul. 1981 - 30 Sep. 1984
Charles R. Wilson and Bruce N. McKibben Nov. 1986 262 p
(Contract F49620-81-C-0091)
(AD-A176804; AFOSR-87-0162TR) Avail: NTIS HC A12/MF A01 CSCL 04/2

In order to monitor atmospheric infrasonic waves in the passband from 0.1 to 0.01 Hz a digital infrasonic detection system was installed in Antarctica on the Ross Ice shelf near McMurdo Station on McMurdo Sound. An array of seven infrasonic microphones subtending an area of about 35 sg km was operated in Windless Bight. The analog microphone data was telemetered to McMurdo station where the infrasonic date were digitized and subjected to on-line real-time analysis to detect traveling infrasonic waves with periods from 10 to 100 seconds. During the period of operation of the Antartic infrasonic observatory, hundreds of infrasonic signals were detected in association with many natural sources such as the aurora australis, marine storm sea-air interactions, volcanic eruptions, mountain generated lee-wave effects, large meteors and auroral electrojet supersonic motions. GRA

N87-21435# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
ELLIPSOIDAL CORRECTIONS TO POTENTIAL COEFFICIENTS OBTAINED FROM GRAVITY ANOMALY DATA ON THE ELLIPSOID
Jaime Y. Cruz Aug. 1986 28 p
(Contract F19628-86-K-0016)
(AD-A176901; OSU/DGSS-371; AFGL-TR-86-0178; SR-1) Avail: NTIS HC A03/MF A01 CSCL 08/5

The spherical harmonic coefficient C sub nm of the disturbing potential T is expressed as an integral of gravity anomaly data delta g sub f assumed to refer to the surface of the reference ellipsoid, plus ellipsoidal correction terms. The ellipsoidal correction terms are intended to remedy the spherical approximations made in the principal integral term regarding the boundary condition relating T and delta g and the shape of the boundary surface. Specifically, two corrections are employed to reflect the use of a boundary condition that now accounts for terms on the order of the earth eccentricity square. In addition three corrections are employed to account respectively for the first, second, and third radial derivative effect in reducing the gravity anomaly from the ellipsoidal boundary surface to the equatorial sphere where the desired spectrum C sub nm applies. Global maps are given to show the effect of the various ellipsoidal correction terms on geoid undulations. The total correction has a global RMS value of about

34 cm in geoid undulation and 3.3 mgals in gravity anomaly, cumulative for degrees n = 2 to 180. GRA

N87-21436# Boston Coll., Chestnut Hill, Mass.
MODEL RESULTS WITH PIIE (POLAR IONOSPHERIC IRREGULARITIES EXPERIMENT) ROCKET DATA Scientific Report, 28 Aug. 1985 - 31 Aug. 1986 986
Robert E. Sheehan 26 Sep. 1986 26 p
(Contract F19628-85-K-0051)
(AD-A176999; AFGL-TR-86-0196; SR-1) Avail: NTIS HC A03/MF A01 CSCL 04/1

Precipitating electron fluxes measured over a polar cap, F-region auroral arc were input to an ionospheric model code that calculates density profiles of various species and the electron temperature. Most model results compare favorably with rocket measurements taken near apogee over the arc. The actual electron temperature is underestimated by the model and the relative densities of some minor species do not agree. Model results show that initial conditions are extremely important for dynamic, short lived (approx. 15 min.) fluxes producing ionization in the F region. The neutral atmosphere underlying the model also influences the electron density profile produced by soft fluxes. Such differences may play a role in the solar cycle dependence of density fluctuation which cause scintillations in the polar cap. GRA

N87-21437# Massachusetts Technological Lab., Inc., West Newton.
THEORETICAL INVESTIGATIONS OF RELEASES OF LITHIUM IN THE EARTH'S MAGNETOSPHERE Final Report, 1 Oct. 1985 - 30 Sep. 1986
Ta-Ming Fang and Robert Hohlfeld 7 Nov. 1986 30 p
(Contract F49620-86-C-0007)
(AD-A177080; MTL-B-8611T; AFOSR-87-0079TR) Avail: NTIS HC A03/MF A01 CSCL 04/1

A detailed dynamic model appropriate for description and simulation of the release of a conducting plasma cloud in an ambient magnetized plasma is developed. Significant elongation of the chemical release cloud along the direction of the ambient magnetic field is predicted. The results will allow detailed treatment of the diamagnetic currents in the outer regions of the chemical release cloud associated with many of the interesting physical processes, such as the current-driven instabilities, of the chemical released event. GRA

N87-21438# Lawrence Livermore National Lab., Calif.
A PARAMETERIZED NUMERICAL FIT TO TOTAL COLUMN OZONE CHANGES CALCULATED BY THE LLNL 1-D MODEL OF THE TROPOSPHERE AND STRATOSPHERE
P. S. Connell Nov. 1986 28 p
(Contract W-7405-eng-48)
(DE87-003600; UCID-20762-Rev-1) Avail: NTIS HC A03/MF A01

Economic analysis of the costs and benefits of regulation of chlorofluorocarbon (CFC) emissions with respect to changes in the total atmospheric ozone column abundance depends on the availability of an accurate means to predict future ozone changes as a function of CFC emissions and trends in other atmospheric species. For the past decade, these predictive calculations have been made chiefly with one-dimensional numerical models of the stratosphere. Although these models, run time-dependently, are substantially more computationally efficient than the more desirable multi-dimensional models, they remain expensive from the viewpoint of the requirements of cost/benefit analysis. Therefore, a numerical parameterization is presented of the results of the LLNL one-dimensional model for total column ozone change in terms of surface emissions or abundances of the various source species. Previous versions of the LLNL model have been used in earlier studies to evaluate time-dependent scenarios of future trends in the emissions or atmospheric abundances of CFC-11, CFC-12, CFC-22, CFC-113, CCl4, CH3CCl3, CO2, CH4, N2O, Halon-1301, Halon-1211. The numerical fit reported here produces calculated ozone changes within about 2% (column ozone change relative to the 1985 model atmosphere) of the current LLNL 1-D model results, for a range of scenarios and ozone changes. It therefore can approximately represent the actual 1-D model for the purposes of economic analysis of regulatory strategies. It is, however, crucial to note that the 1-D model results, and consequently this parameterization, are subject to substantial uncertainties. Future improvements in the knowledge of atmospheric photochemical kinetics and transport in the troposphere and stratosphere are expected to modify these current results. DOE

N87-21439# Joint Inst. for Nuclear Research, Dubna (USSR).
GRAVITATION WAVES. PROCEEDINGS OF THE CONFERENCE ON DESIGN OF GRAVITATIONAL WAVE RADIATOR AND DETECTOR
1985 173 p In RUSSIAN Presented at the Conference on the History of Particle Physics, Dubna, USSR, 25 Jun. 1985
(DE87-780075; JINR-R-2-85-667; CONF-8506332) Avail: NTIS (US Sales Only) HC A08/MF A01

Separate abstracts were prepared of 20 papers presented at this conference on gravity wave radiation and detection. Among the topics discussed were the following: experiment design for the radiation and detection of gravity waves in the laboratory; development of a vibrational base for the Gravity apparatus; designing the substructure for the gravity wave device; parametric transformation of the weak gravity wave into the electromagnetic in the three-level system; gravity wave detection with the aid of resonance multiwave parametric processes; the influence of the structure of the impulse of coherent radiation on the stability of the anticipated gravity waves from monocrystals; the possibility of the detection of high frequency gravity radiation via laser interferometry; some examples of noise in laser interferometry gravity wave antennas; the optical resonator in the gravity wave field; the gravity wave detector on the basis of light diffraction; the detection of slight variations in Earth's gravitational field with the aid of optical laser interferometry; and the writing of a dictionary of gravity related terms. DOE

N87-21440# Los Alamos National Lab., N. Mex.
OBSERVATIONS AND THEORY OF THE AMPTE (ACTIVE MAGNETOSPHERIC PARTICLE TRACER EXPLORERS) MAGNETOTAIL BARIUM RELEASES
P. A. Bernhardt, R. A. Roussel-Dupre, M. B. Pongratz, G. Haerendel, A. Valenzuela, D. A. Gurnett, and R. R. Anderson Jan. 1987 48 p
(Contract W-7405-eng-36)
(DE87-006325; LA-10904-MS) Avail: NTIS HC A03/MF A01

The barium releases in the magnetotail during the Active Magnetospheric Particle Tracer Explorers (AMPTE) operation were monitored by ground-based imagers and by instruments on the Ion Release Module. After each release, the data show the formation of a structured diamagnetic cavity. The cavity grows until the dynamic pressure of the expanding ions balances the magnetic pressure on its surface. The magnetic field inside the cavity is zero. The barium ions collect on the surface of the cavity, producing a shell. Plasma irregularities form along magnetic field lines draped over the surface of the cavity. The scale size of the irregularities is nearly equal to the thickness of the shell. The evolution and structuring of the diamagnetic cavity are modeled using magnetohydrodynamics theory. DOE

N87-21441# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
HAUTE-PROVENCE (FRANCE) OBSERVATORY LIDAR STATION, SUMMARY AND OUTLOOK (1981-1986) [STATION LIDAR DE L'OBSERVATOIRE DE HAUTE-PROVENCE: BILAN ET PERSPECTIVES (1981-1986)]
Oct. 1986 123 p In FRENCH
(ETN-87-99365) Avail: NTIS HC A06/MF A01

Lidar observatory laboratory equipment and facilities; detection of sodium at the mesopause using optical resonance lidar; the interactions of volcanic aerosols with atmospheric equilibrium state; ozone measurements; and Rayleigh lidar density and temperature measurements are described. ESA

N87-21442# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
[ACTIVITIES REPORT IN AERONOMY] Annual Report, 1985 [SERVICE D'AERONOMIE, RAPPORT D'ACTIVITE, ANNEE 1985]
1 Sep. 1986 187 p In FRENCH Revised
(ETN-87-99366) Avail: NTIS HC A09/MF A01

Lower and middle atmosphere studies; solar system exploration such as the Vega sounding of Venus atmosphere and the Vesta Mars exploration program; cosmic background spectrometry; teledetection of sea fluorescence; and measuring techniques are described. ESA

N87-21443# Uppsala Ionospheric Observatory (Sweden).
SPREAD F: THE SCANDINAVIAN SCENE
Harald Derblom Oct. 1986 55 p
(Contract FOA-310775)
(UIO-SR-86-02; ISSN-0349-2699; ETN-87-99435) Avail: NTIS HC A04/MF A01

Spread-F morphology and formation mechanisms are reviewed. Results from a statistical study of the spread-F occurring in the ionosonde data from the Swedish stations at Uppsala, Lycksele, and Kiruna are presented. Spread-F is primarily a wintertime nocturnal phenomenon with occurence subpeaks around sunrise/sunset. Spread, greater than 0.3 MHz, is observed maximally during 80% of the midwinter, midnight hours at Uppsala, 50% occurrence probability is found in Lycksele data and 43% in Kiruna data. Severe spread has a maximum temporal occurrence probability of 64% at Uppsala, 18% at Lycksele, and 29% at Kiruna. The sunspot cycle variation is most clearly found in the Lycksele data. The average ratio of occurrence from maximum to minimum years is 5. The subpeak of occurrence around sunrise/sunset is correlated with the ionospheric E-level sunrise/sunset. It is suggested that E-region irregularities are mapped up the geomagnetic field lines to the F-region giving rise to the spread-F. ESA

N87-21444# Kiruna Geophysical Inst. (Sweden).
INVESTIGATION OF PRECIPITATING ELECTRONS DURING AN AURORAL BREAKUP
Ingrid Sandahl, Lars Eliasson, and Bengt Holback Nov. 1986 21 p
(KGI-Preprint-096; ISSN-0349-2656; ETN-87-99436) Avail: NTIS HC A02/MF A01

During a breakup aurora a sounding rocket detected two different types of particle spectra. The optical aurora was monitored by low light level TV. The first type of spectra consisted of two populations, a low energy population of secondary electrons and a plasma sheet population. The second type of spectra was generally connected to bright aurora and contained a Maxwellian population with a characteristic energy of a few hundred eV in addition to the previous two populations. The few hundred eV Maxwellian and the plasma sheet population were accelerated in a potential drop parallel to the magnetic field lines. It is suggested that the parallel potential drops exist on field lines magnetically connected to the regions in the distant magnetosphere where the few hundred eV population is present. ESA

N87-21445# Kiruna Geophysical Inst. (Sweden).
A NEW METHOD OF ORGANIZING SPECTRAL LINE INTENSITY RATIO FLUCTUATIONS OF AURORAL AND NIGHTGLOW EMISSIONS
Bo Thelin Nov. 1986 24 p Presented at the 14th Annual Meeting on Atmospheric Studies by Optical Methods, Cambridge, England, 17-22 Aug. 1986
(KGI-193; ISSN-0283-1694; ETN-87-99437) Avail: NTIS HC A02/MF A01

A linearization effect in atmospheric auroral and nightglow emissions was studied with a spectrophotometer in auroral emissions, where linear graphs were obtained on different auroral occasions. Results show the importance of the inelastic scattering cross section between electrons-atoms and electrons-molecules. It is possible to determine the mean energy of the interacting thermal electrons which are active in the different auroral phases. ESA

N87-21446# Danish Meteorological Inst., Copenhagen.
AVERAGE CONFIGURATION OF THE QUIET AURORAL OVAL
K. Lassen, C. Danielsen, and C.-I. Meng 1986 39 p
(DMI-Geophys-Papers-R-73; ISBN-87-7478-270-3; ETN-87-99451)
Avail: NTIS HC A03/MF A01

The precipitation pattern of auroral electrons measured by DMSP-satellites during magnetically quiet intervals is compared with the classical (Feldstein) auroral oval and similar configurations of auroral emission. The electron precipitation takes place in a annular belt which is found to coincide with the 6300A oval observed with the ISIS-2 satellite. The outer belt (average energy greater than 500 eV) coincides with the 3914A mantle aurora zone and includes the Feldstein oval. It is absent in the afternoon. The inner, low-energy belt is observed from 03 hr to 21 hr MLT. The daytime discrete auroras are embedded in this belt. The quiet time discrete auroral belt is formed by a combination of discrete auroras in the night time Feldstein oval and high-latitude daytime forms. This quiet configuration is not identical with the Feldstein oval. The quiet time annular belt of precipitating auroral electrons is a composite of the mantle aurora zone, the Feldstein oval, and the high-latitude daytime auroral emission belt. ESA

N87-21447# Rome Univ. (Italy). Dipt. di Fisica.
STUDY OF THE FREE OSCILLATIONS OF THE EARTH BASED ON GRAVITIONAL ANTENNA DATA [STUDIO DELLE OSCILLAZIONI LIBERE DELLA TERRA NEI DATI DELL'ANTENNA GEOGRAV]
M. Gabellieri 17 Jul. 1986 37 p In ITALIAN
(Nota-Interna-868; ETN-87-99761) Avail: NTIS HC A03/MF A01

The correlations between spectral parameters of gravitational antenna data with Earth oscillations are studied. The measuring instruments of the Geograv experiment are described as well as the data analysis procedures. It is found that periodical data is correlated to Earth oscillations; Earthquake excitation of the free oscillations of Earth is discussed. ESA

N87-21448# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 507, NOVEMBER 1986. PART 1: (PROMPT REPORTS). DATA FOR OCTOBER, SEPTEMBER 1986 AND LATE DATA
Helen E. Coffey, ed. Nov. 1986 123 p
(PB87-137766; SGD-507-Pt-1; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A06/MF A01 CSCL 04A

The contents of Solar-Geophysical Data Number 507, November 1986 Part 1 (Prompt Reports) are as follows: (1) Detailed index for 1986; (2) Data for October 1986-- IUWDS alert periods (Advanced and worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field; (3) Data for September 1986-- Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices; and (4) Late data-- Solar radio emission, Solar active regions January-August 1986, Cosmic ray measurements by neutron monitor, Geomagnetic indices, Calcium plage data March-April 1986. GRA

N87-21449# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 507, NOVEMBER 1986. PART 2: (COMPREHENSIVE REPORTS). DATA FOR MAY 1986 AND MISCELLANEA
H. E. Coffey, ed. Nov. 1986 36 p
(Contract N00014-86-F-0049)
(PB87-137774; SGD-507-Pt-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A03/MF A01 CSCL 04A

Solar-Geophysical Data Number 507, November 1986, Part 2 (Comprehensive Reports), Data for May 1986, and miscellanea, contains the following: Detailed index for 1986; Data for May 1986--(Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar X-ray radiation from GOES satellite, Mass ejection from the Sun, Active prominences and filaments);

Miscellaneous data--(International geophysical calender 1987).
GRA

N87-21450*# National Academy of Sciences - National Research Council, Washington, D. C. Commission on Physical Sciences, Mathematics and Resources.
ATMOSPHERIC CLIMATE DATA: PROBLEMS AND PROMISES Final Report
1986 103 p Sponsored by NASA, NOAA, NSF and National Climate Program Office
(NASA-CR-180442; NAS 1.26:180442; PB87-126561) Avail: NTIS HC A06/MF A01 CSCL 04A

The explosive growth in the quantity and diversity of weather and climate data, the growing handicap that the distinction between weather and climate in NOAA imposes on the efficient management and use of data is discussed. Also discussed is the uncertainty induced by the lack of clear commitment and consistent policies regarding federal roles and responsibilities in operating and maintaining the national weather and climate data system. Author

N87-21483# Helsinki Univ. (Finland). Dept. of Meteorology.
GLOBAL DIAGNOSTIC STUDIES BASED ON DATA COLLECTED DURING THE GLOBAL EXPERIMENT
Eero Holopainen *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 255-275 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

N87-21484# Moscow State Univ. (USSR).
DIAGNOSTIC RESEARCH INTO THE TROPICAL ATMOSPHERE AND THE ROLE OF TROPICAL PROCESSES IN THE GENERAL CIRCULATION
M. A. Petrossiants and I. G. Sitnikov *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 277-291 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

N87-21494# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. for Atmospheric Physics.
VERTICAL AIR MOTION AND TURBULENCE PARAMETERS FROM COMMERCIAL AIRCRAFT
P. Gysel and H. Richner *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 95-105 Sponsored by the Swiss National Science Foundation (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

N87-21514# Istituto di Fisica dell Atmosfera, Rome (Italy).
STRATIFIED FLOW AND WAVE MOTION NEAR MOUNTAIN TOPS
F. Tampieri and J. C. R. Hunt *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 359-369 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

N87-21516# Wyoming Univ., Laramie. Dept. of Mechanical Engineering.
LABORATORY SIMULATION OF ROTATING STRATIFIED FLOW OVER AND AROUND THE ALPS
Don L. Boyer, Ruirong Chen, and Peter A. Davies *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 391-404 (For primary document see N87-21485 14-47)
(Grants NSF ATM-80-18173; NSF ATM-82-18488)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N87-21451# National Weather Service, Washington, D.C. Climate Analysis Center.
MONTHLY AND SEASONAL WEATHER OUTLOOK FOR NOVEMBER 1986, VOLUME 40, NUMBER 21, OCTOBER 30, 1986
30 Oct. 1986 10 p
(PB87-118980) Avail: NTIS HC A02/MF A01 CSCL 04B

The report includes temperature and precipitation probabilities of the Northern Hemisphere for November 1986. GRA

N87-21452# National Bureau of Standards, Gaithersburg, Md.
HANDBOOK FOR THE QUALITY ASSURANCE OF METEOROLOGICAL MEASUREMENTS Final Report
J. K. Taylor and H. V. Oppermann Nov. 1986 290 p
(PB87-140422; NBS/HB-14; LC-86-600583) Avail: NTIS HC A13/MF A01; Also Avail. from Supt. of Documents as SN003-003-02774-0 CSCL 04B

The general concept of quality assurance for meteorological measurements is discussed. A number of Good Laboratory Practices (GLPs) and Good Measurement Practices (GMPs) related to meteorology are compiled. Twenty recommended Standard Operations Procedures (SOPs) for high-accuracy mass, length, and volumetric calibrations made most frequently by State weights and measures laboratories are included. The statistical techniques useful for evaluating measurement quality are reviewed. Control charts most useful for meteorological measurements are discussed.
GRA

N87-21453# European Space Agency, Paris (France).
PROCEEDINGS OF THE METEOROLOGICAL MOTOR GLIDER (MEMO) WORKSHOP
Nov. 1986 210 p Transl. into ENGLISH of "Beitrag zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 213 p Workshop held in Oberpfaffenhofen, West Germany, 1-5 Oct. 1984 Original language document was announced as N85-35542
(ESA-TT-945; DFVLR-Mitt-85-04; ETN-87-99426) Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Motor glider meteorology and the history of motor gliders used for meteorological flight are reviewed. Vertical wind velocity determination using aircraft motion is discussed. Meteorological data from the Falcon aircraft and the ASK 16 motor glider are compared. Atmospheric boundary layer turbulence is investigated. Environmental meteorological data in urban areas are examined. The concept of Lagrangian partitioning was applied to turbulent energy transport. Horizontal and vertical structure of the boundary layer, and the energy budgets above rural and urban areas are treated. Lee circulation in a Foehn wind is studied. A data acquisition system for meteorological measurements onboard light aircraft is developed. Accuracy and error analysis of meteorological measuring data is considered. The principles of wind velocity measurements onboard research aircraft are presented. For individual titles, see N87-21454 through N87-21469.

N87-21454# European Space Agency, Paris (France).
MOTOR GLIDER METEOROLOGY
Helmut Kraus *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 10-13 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 11-13 Original language document was announced as N85-35543 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Methods of dividing meteorological sciences in partial domains are given, and the requirements and tasks of motor glider meteorology are depicted. It is explained that motor gliders are especially suited for the experimental determination of processes

and structures on a micro and mesoscale and of micro-mesoscale interactions. ESA

N87-21455# European Space Agency, Paris (France).
TYPICAL AND HISTORICAL ASPECTS OF MOTOR GLIDERS AS METEOROLOGICAL MEASURING AIRCRAFT c05
Manfred E. Reinhardt *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 14-29 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 14-29 Original language document was announced as N85-35544 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

The history of motor gliders used for meteorological flight since 1920 is depicted. Motor glider is defined. Historical requirements for gliding aircraft with built-in motor are mentioned. The characteristics of motor gliders, their wing loading, and motor power are shown. The milestones marked by these motor gliders are explained. The expectations for meteorological measurements with motor gliders are outlined. ESA

N87-21456# European Space Agency, Paris (France).
DETERMINATION OF VERTICAL AIR VELOCITY USING MEASUREMENTS OF THE AIRCRAFT MOTION
Markus Hutter *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 30-42 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 29-42 Original language document was announced as N85-35545 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Absolute air velocity is determined from the movements of an aircraft. Determination of aircraft motion in a vertical plane is described; the vertical equation of motion and the calculation of an average position angle are discussed. Good agreement is found between measured and calculated angles. The sensitivity of the results to the position angle is discussed. ESA

N87-21457# European Space Agency, Paris (France).
INFLUENCING VARIABLES IN THE ASSESSMENT OF VERTICAL WIND VELOCITY BY MEANS OF FLIGHT-MECHANICS EQUATIONS
Klaus-Uwe Hahn and Chang-Jiang Jin *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 43-60 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 43-60 Original language document was announced as N85-35546 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

A measuring method for the determination of the vertical wind velocity using small measuring aircraft (e.g., motor gliders) is developed. During the flight through a wind field, wind velocity fluctuations act on the aircraft in the form of additional forces. Aircraft reactions to these perturbations depend strongly on the steering maneuvers of the pilot. From this response behavior of the aircraft conclusions can be drawn as to the wind behavior if the aircraft dynamics are precisely known. The wind determination procedure can be simplified if only vertical wind is taken into account and if stationary behavior is assumed. The validity domain of these simplifying assumptions and the effect of measuring quantity errors (investigated by simulations) are discussed. ESA

N87-21458# European Space Agency, Paris (France).
A COMPARISON BETWEEN FALCON DATA AND MOTOR GLIDER DATA
Hermann Willeke *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 61-68 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorlogischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, Report DFVLR-Mitt-85-04, Jan. 1985 p 61-68 Original language document was announced as N85-35547 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

The data of the Falcon aircraft and the ASK 16 motor glider meteorological flight under the same meteorological conditions are compared to estimate errors in the determination of the vertical wind component. Flight data and equipment of both aircraft are listed. The flight programs, data evaluation, and comparison method are described. The parameters measured by both aircraft are listed. The power spectra to the vertical velocity show good agreement. The differing relative deviations in heat fluxes shows that at least one unknown effect occurs. ESA

N87-21459# European Space Agency, Paris (France).
CASE STUDIES FOR FLUX MEASUREMENTS ALONG A LOW-FLYING ROUTE TO THE SOUTH OF MUNICH
Manfred E. Reinhardt *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 69-80 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 69-79 Original language document was announced as N85-35548 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Turbulent, sensible, and latent heat fluxes along low flying motor glider routes are measured to study the atmospheric boundary layer. The behavior of sensible and latent heat fluxes on days with different meteorological conditions is discussed. Normalized frequency distributions of all measured vertical accelerations during measuring of flights are shown. Improvements of the measuring strategy are proposed to allow deeper analysis of the fine structure of atmospheric boundary layer phenomena. ESA

N87-21460# European Space Agency, Paris (France).
ENVIRONMENTAL-PHYSICAL MEASUREMENTS AND DETERMINATION OF ATMOSPHERIC TURBULENCE WITH THE ASK-16 MOTOR GLIDER
Markus Hutter *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 81-90 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 81-90 Original language document was announced as N85-35549 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Meteorological motor glider flights are performed to determine environmental and atmospheric turbulence parameters. Temperature and humidity probes used in the project CLIMOD (climate modification) studying the effect of increasing urbanization and planned nuclear power plants with cooling system on the climate, and the results of the measurements and model calculations are discussed. Ozone in the lower troposphere due to the existence of smog reactions in the neighborhood of Zurich is investigated in ground stations and with two captive balloons; the regional ozone distribution was measured by motor gliders; the measurements strongly point at the Zurich agglomeration as the origin of the ozone-rich air. The motions of motor gliders due to air flows are used to determine atmospheric turbulence in the wavelength domain between 10 and 100 m; the measurements confirm previous results; agreement between the measurements and a mathematical turbulence parameterization model is found. ESA

N87-21461# European Space Agency, Paris (France).
MEASUREMENTS OF THE VERTICAL STRUCTURE OF THE CONVECTIVE BOUNDARY LAYER
Anne M. Jochum *In its* Proceedings of Meteorological Motor Glider

(MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 91-97 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 91-97 Original language document was announced as N85-35550 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

A meteorological measuring compaign with motor gliders is performed to investigate turbulent vertical transport in the convective boundary layer and the spatial structure of thermal air fields. The measuring procedures are described. The vertical profiles measured and normalized (mixed-layer scaling) can be well integrated in the framework of similar profiles. ESA

N87-21462# European Space Agency, Paris (France).
PARTIONING OF THE VERTICAL TURBULENT ENERGY TRANSPORT INTO POSITIVE AND NEGATIVE CONTRIBUTIONS
Joerg M. Hacker *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 98-116 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 99-114 Original language document was announced as N85-35551 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

The concept of Lagrangian partitioning is applied to motor glider meteorological flight measuring series in order to study which single processes contribute to the turbulent net vertical transport of sensible and latent heat. Normalization and data evaluation procedures are described. It is found that in the upper level of the inversion layer the net fluxes consist of much higher single contributions than in the lower level, especially for the sensible heat flux. At both levels the moist, then hot, wakes give the largest contribution to the direct circulations, while the hot wakes give the largest contribution to the indirect circulations. For sensible heat the intensities of the processes due to hot air dominate at both levels. For latent heat the intensities of the processes due to moist air only dominate at the lower level. ESA

N87-21463# European Space Agency, Paris (France).
AIRCRAFT MEASUREMENTS DURING THE BONN EXPERIMENT (BONEX 1)
Volker Kespe *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 117-135 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 115-133 Original language document was announced as N85-35552 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Meteorological measurements are performed to investigate the horizontal and vertical structure of the atmospheric boundary layer. Two captive balloon systems, an energy budget station, and instrumented motor gliders are used. The synoptic measuring situation is described. The effect of the mask on the motor glider measurements of the lowest flight level is discussed. The spatial and temporal variation of the standard deviations of vertical wind velocity, potential temperature, and specific humidity, and of the correlation coefficients, as well as the turbulent fluxes of sensible and latent heat are obtained. The profile of the standard deviations are discussed. ESA

N87-21464# European Space Agency, Paris (France).
MOTOR GLIDER MEASUREMENTS DURING THE URBAN ATMOSPHERE ENERGY BUDGET EXPERIMENT (EESA 1)
Joerg M. Hacker *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 136-145 Transl. into ENGLISH from "Beitrage zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 135-141 Original language document was announced as N85-35553 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Meteorological measurements to compare energy budgets in rural and urban areas, and to study terms in the energy budget of sensible and latent heat are performed. The measurements of several ground stations, a radiosonde, two captive balloons, and a motor glider are combined. The model on which the investigation is based and the measuring strategy are described. The measured energy fluxes above the city and the surroundings are presented. The differences in the energy budgets of the boundary layer above the two areas are discussed. ESA

N87-21465# European Space Agency, Paris (France).
THE DETERMINATION OF LEE CIRCULATION DURING THE FOEHN WIND
Klaus P. Hoinka *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 146-153 Transl. into ENGLISH from "Beitrag zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 143-149 Original language document was announced as N85-35554 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

A field experiment, including measurements with motor gliders, was conducted to determine the circulation above and in the lee of the Alps during the Foehn wind. Pressure, temperature, and humidity are measured and the isentropes are analyzed. Flow lines and trajectories agree with the isentropes, under the assumption that the flow is two-dimensional, frictionless, and adiabatic. The results show that motor gliders can provide an important contribution to the investigation of partial problems, as in the case of Foehn, especially in connection with other measurements and investigation methods. ESA

N87-21466# European Space Agency, Paris (France).
METEOROLOGICAL MEASUREMENTS WITH MOTOR GLIDERS IN POLAND
Szymon P. Malinowski *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 154-159 Transl. into ENGLISH from "Beitrag zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, Report DFVLR-Mitt-85-04, Jan. 1985 p 151-156 Original language document was announced as N85-35555 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Meteorological measuring campaigns with instrumental motor gliders study small scale humidity and temperature inhomogeneities caused by dissipating cumulus clouds; and the invisible parts of cooling tower plumes. A program to investigate entrainment and mixing processes in small cumulus clouds is outlined. The motor glider instrumentation and the specification of the measuring unit are presented. The motor glider SZD-45 Ogar is described. ESA

N87-21467# European Space Agency, Paris (France).
DEVELOPMENT AND OPERATION OF A MEASURING DATA ACQUISITION SYSTEM FOR USE IN LIGHT AIRPLANES c06
Peter Huber *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 160-162 Transl. into ENGLISH from "Beitrag zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 157-160 Original language document was announced as N85-35556 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

A data acquisition system weighing 35 kg is developed for use onboard light aircraft. The basic concept of the system (task definition, requirements) is given. Development status (onboard

components, special systems, ground components, measuring data recorder, technical data, and data evaluation software) is presented. The performed measurements are reviewed. ESA

N87-21468# European Space Agency, Paris (France).
ACCURACY AND ERROR ANALYSIS c65
Jean Skudridakis *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 163-192 Transl. into ENGLISH from "Beitrag zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 161-194 Original language document was announced as N85-35557 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

Accuracy estimation and error analysis of physical quantities measured during flights are treated. The standard deviation of the Gaussian distribution as criterion for the uncertainty of the measured quantity is discussed. Accuracy estimates via the covariance matrices of the state and measurement equations, and via system identification are explained. The effect of the measurement precision, and a dynamic angle of attack equation are given. The example of air and recovery temperature measurement is presented. ESA

N87-21469# European Space Agency, Paris (France).
PRINCIPLES OF WIND MEASUREMENT WITH THE HELP OF AIRCRAFT
Peter Voersmann *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 193-209 Transl. into ENGLISH from "Beitrag zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 195-205 Original langauge document was announced as N85-35558 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

The three components of the wind vector are computed in real time by taking the difference between the inertial velocity and the true airspeed. To perform this calculation, it is necessary to transform the true airspeed from the aerodynamic to the Earth-fixed coordinate system. This coordinate transformation contains numerous trigonometric functions (sine and cosine functions), which yield nonlinear relations for the determination of the wind vector components. These relations present the theoretical principles for measuring winds onboard an aircraft. ESA

N87-21470# World Meteorological Organization, Geneva (Switzerland).
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON THE RESULTS OF THE GLOBAL WEATHER EXPERIMENT AND THEIR IMPLICATIONS FOR THE WORLD WEATHER WATCH, VOLUME 1 Global Atmospheric Research Program
Apr. 1986 389 p Conference held in Geneva, Switzerland, 27-21 May 1985 Prepared in cooperation with ICSU, Rome, Italy (WMO-TD-107-Vol-1; GARP-Publ-26-Vol-1; ETN-87-99177) Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The backgroung to GARP and the Global Weather Experiment; the observing system for the Global Weather Experiment; special observing systems in the Global Weather Experiment and their applicability in the context of World Weather Watch; and data analysis and diagnostic studies in the Global Weather Experiment were discussed. For individual titles, see N87-21471 through N87-21484.

N87-21471# Stockholm Univ. (Sweden).
THE OBJECTIVES OF THE GLOBAL WEATHER EXPERIMENT AND OVERALL VIEW OF THE ACCOMPLISHMENT OF GARP
Bert Bolin *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 3-18 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The Global Atmospheric Research Program (GARP) formulated the scientific requirements for a global weather experiment to advance knowledge about the principal factors that govern the general circulation of the atmosphere. The impact of satellite development on international collaboration in meteorology; GARP organization and international cooperation; and the process of defining objectives are recalled. ESA

N87-21472# Princeton Univ., N. J.
GARP'S OBJECTIVES IN WEATHER PREDICTION. EXPECTATIONS AND REALIZATIONS
Joseph Smagorinsky *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 19-34 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The evolution of the scientific foundations of GARP is reviewed. In 1960, a rudimentary less-than-global observing system provided marginally adequate initial conditions for balanced or geostrophic baroclinic models of a few levels designed to produce forecasts for a day or two. The physical limitations on predictability were poorly understood, data assimilation methods were primitive, and the means for improving numerical prediction models were elusive. The 1960's provided the opportunity to plan a comprehensive and coherent research program which would take advantage of new technologies, satellites and computers, for a systematic attack by the international community of scientists and governments. It was clear that process studies, such as in the boundary layer, in the tropics, and in the monsoon regions were a necessary part of the new strategy. It culminated in a year-long global experiment that provided the global data which would lead to improved models, a better understanding of key processes, extended predictive skill, and more effective observational systems. ESA

N87-21473# Committee on Space Research, Paris (France).
COSPAR'S CONTRIBUTION TO THE EARLY PLANNING OF THE GLOBAL OBSERVING SYSTEM OF THE GLOBAL WEATHER EXPERIMENT
Morris Tepper *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 37-45 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Cooperation between COSPAR, the WMO, the UN, and the International Council of Scientific Unions in planning the World Weather Watch and the Global Atmospheric Research Program is recalled. ESA

N87-21474# International Meteorological Inst., Stockholm (Sweden). Arrhenius Lab.
THE OBSERVATIONAL OBJECTIVES AND THE IMPLEMENTATION OF THE GLOBAL WEATHER EXPERIMENT
B. R. Doeoes *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 47-74 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The transformation of the main scientific objectives of the Global Weather Experiment into observational requirements and the design of the FGGE composite global observing system as eventually implemented are described. In addition to the surface based World Weather Watch Global Observing System it included geostationary and polar orbiting meteorological satellites, dedicated ships and long range aircraft making soundings in the equatorial tropics, constant level balloons drifting at 14 km providing observations of the atmospheric flow in the tropics, and buoys drifting in the southern ocean making observations at the sea surface. Meteorological data were obtained using a large number

of commercial aircraft equipped with special observing systems. It is concluded that the observations obtained during the 2 Intensive Special Observing Periods (15 January to 20 February, and 10 May to 8 June, 1979) provided nearly all the data stated in the requirements for the Experiment. ESA

N87-21475# Johnson (David S.), Annapolis, Md.
METEOROLOGICAL PARAMETERS DERIVED FROM SPACE-BASED OBSERVING SYSTEMS, DURING THE GLOBAL WEATHER EXPERIMENT AND AFTER
David S. Johnson *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 75-109 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Global coverage by geostationary and polar orbiting meteorological satellites during the Global Weather Experiment (GWE) for data collection from in situ platforms and remote sensing of the atmosphere and the earth's surface is reviewed. Quantitative data for the GWE derived from satellite observations were upper air winds, most commonly at 900 and 300 mb, upper air and sea surface temperatures, and total atmospheric precipitable water content in cloud-free areas. There is considerable improvement in the quality of these data since the conclusion of the GWE observing year as a result of improvements introduced into the data processing schemes. Root-mean-square differences between satellite determinations and in situ observations, compared to the estimated errors due to the large-scale sampling differences combined with the errors of the in situ observations themselves (radio-wind, radiosonde and drifting buoys) confirm the key contribution of satellites to large-scale programs. ESA

N87-21476# Japan Meteorological Agency, Tokyo.
IMPROVEMENTS IN GEOSTATIONARY SATELLITE WIND OBSERVATIONS AS A RESULT OF THE GLOBAL WEATHER EXPERIMENT AND APPLICATIONS OF THESE IN THE CONTEXT OF THE WORLD WEATHER WATCH (WWW) SYSTEM
T. Hamada *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 113-132 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The history and status of satellite wind observing systems are summarized. Satellite winds are essential for the analysis of the meteorological fields and climate research, especially over tropical areas. They agree well with conventional winds in most cases. However, it is pointed out that they are mostly obtained only on two levels, and the difficulty of height assignment sometimes causes conspicuous errors in the satellite winds, particularly at high levels, e.g., jet-stream cirrus in midlatitutes. In order to overcome these problems, additional sensors such as water vapor (6.8 micron) split window (11.5 and 12.5 micron) and CO2 (13.3, 14.0, and 14.2 micron) channels are helpful. It is suggested that 15 min interval images should be used for operational cloud tracking in the Global Observing System/World Weather Watch network. ESA

N87-21477# Direction de la Meteorologie Nationale, Paris (France).
AUTOMATIC MOBILE PLATFORMS c18
Claude Pastre *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 133-144 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Polar orbit NOAA meteorological satellites equipped with ARGOS instrumentation were used during the FGGE for the implementation of the Tropical Constant Level Balloon and Drifting Buoy Programs. Although the balloon program supplied excellent upper wind measurements, practical difficulties prevent the balloons from being used as an operational system in the World Weather Watch. Drifting buoys, however seem to have good potential as an operational system. It should be possible to constitute a system at reasonable operational cost, providing good quality data from which surface pressure analyses and reference measurements of ocean surface temperature could be obtained. A global network could be established on a progressive basis, starting with the implementation of regional networks. ESA

N87-21478# Atmospheric Environment Service, Downsview (Ontario).
THE AIRCRAFT TO SATELLITE DATA RELAY: ASDAR c18
Jaan Kruss *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 145-155 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The Aircraft to Satellite Data Relay (ASDAR) system was used in the Global Weather Experiment to demonstrate the feasibility of transmission of meteorological data from suitably equipped aircraft via the International Data Collection System on the Geostationary Satellite System. A total of 17 ASDAR units were installed on aircraft of the U.S. Air Force and 8 airlines from 8 countries. This fleet collected 230,000 data points for the FGGE Level 2 data set. The data on wind and temperature are accurate. The data are particularly valuable in the Southern Hemisphere and several prototype units continue in operation. Experience from the prototypes and analyses undertaken as part of FGGE were used to specify operational equipment under development. ESA

N87-21479# Finnish Meteorological Inst., Helsinki.
NAVIGATIONAL AID (NAVAID) VERTICAL SOUNDING SYSTEM
Antti A. Lange *In* WMO Proceedings of the International Conference on the Results of the Global Weather Watch and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 157-175 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

In order to obtain vertical wind profiles from aircraft and ships without a stabilized radar platform, FGGE used retransmitted NAVigational AID (NAVAID) signals. The NAVAID vertical sounding systems were based on the international Omega Navigation System and were successfully operated by an international research fleet of ships and aircraft in remote tropical ocean areas during the FGGE Special Observing Periods. Fundamental experience on advantages and disadvantages of the NAVAID windfinding was gained. The method provides a practical tool for the meteorological instrumentation of the World Weather Watch. ESA

N87-21480# Hydrometeorological Centre of the USSR (Moscow).
SHIP-BORNE SYSTEMS FOR OBSERVING WIND IN THE TROPICAL ZONE
B. S. Chuchkalov and N. A. Zaitseva (Central Aerological Observatory, Moscow, USSR.) *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 177-183 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

During the FGGE, radar tracking of radiosondes from stabilized platforms produced detailed data on the distribution of the characteristics of meteorological parameters in the troposphere and lower stratosphere. The polygon arrangement of ships participating in the MONEX experiments gave a general idea of the wind in the equatorial zone, and provided the basis for calculations of the thermodynamic characteristics, including vertical speeds, around the periphery of stationary and moving polygons. Spatiotemporal and temporal variations in the fine structure of the equatorial atmosphere during the development of the winter and summer monsoons were analyzed. ESA

N87-21481# European Centre for Medium-Range Weather Forecasts, Reading (England).
FOUR-DIMENSIONAL DATA ASSIMILATION
Lennart Bengtsson *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 187-216 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Four-dimensional meteorological data assimilation, whereby past observations are projected onto a future state following the trajectories of the prediction model, is introduced. Intermittent assimilation and continuous assimilation are described. In both methods optimum interpolation is used to interpolate the observational data to a more or less regular grid. The interpolation is done for every model time-step in continuous data assimilation and once every 6 or 12 hr in intermittent assimilation. The optimum interpolation procedure acts as a statistical scale-dependent filter of the observational data, as well as performing the necessary interpolation from randomly distributed observation points to a regular grid. ESA

N87-21482# Princeton Univ., N. J. Geophysical Fluid Dynamics Lab.
ASSESSMENT OF RESULTS FROM DIFFERENT ANALYSIS SCHEMES
K. Miyakoda *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 217-253 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Data assimilation schemes developed during the Global Atmospheric Research Program are reviewed. For the intermittent scheme of data assimilation, the multivariate version is instrumental for incorporating various sources of observed data. For continuous assimilation, normal mode initialization turned out to be a breakthough for obtaining the dynamical balance between the mass fields and winds. Problems associated with tropical and seasonal forecasts are discussed. ESA

N87-21483# Helsinki Univ. (Finland). Dept. of Meteorology.
GLOBAL DIAGNOSTIC STUDIES BASED ON DATA COLLECTED DURING THE GLOBAL EXPERIMENT **c46**
Eero Holopainen *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 255-275 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Based on FGGE data, a geographical global distribution of divergent energy fluxes and the associated heat sources and sinks was obtained. Large-scale features and seasonal march appear realistic. Studies of angular momentum budget with FGGE data show that mountain torque accounts for the fluctuations of the globally-integrated changes of angular momentum in the atmosphere. Apparently realistic estimates of the variation of the global amounts of available potential energy and kinetic energy are obtained. Large uncertainties, particularly in the tropics, in the observed values of quantities, especially those related to the moisture and divergent wind are discussed. Reproduction of the Level 3-b analyses with improved Level 2-b data and improved data assimilation systems is needed. ESA

N87-21484# Moscow State Univ. (USSR).
DIAGNOSTIC RESEARCH INTO THE TROPICAL ATMOSPHERE AND THE ROLE OF TROPICAL PROCESSES IN THE GENERAL CIRCULATION **c46**
M. A. Petrossiants and I. G. Sitnikov *In* WMO Proceedings of the International Conference on the Results of the Global Weather Experiment and their Implications for the World Weather Watch, Volume 1 Apr. 1986 p 277-291 (For primary document see N87-21470 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The structure of tropical disturbances such as easterly waves, tropical cyclones, cyclonic and anticyclonic eddies in the upper trosposphere, squall lines, monsoon depressions, inter-tropospheric cyclones in the Asian monsoon, subtropical cyclones over the oceans, and mesoscale depressions in the Inter-Tropical Convergence Zone is discussed. Use of FGGE data is described. ESA

N87-21485# World Meteorological Organization, Geneva (Switzerland).
PROCEEDINGS OF THE CONFERENCE ON THE SCIENTIFIC RESULTS OF THE ALPINE EXPERIMENT (ALPEX), VOLUME 1 Global Atmospheric Research Program
Jul. 1986 443 p Conference held in Venice, Italy, 28 Oct. - 1 Nov. 1985 Prepared in cooperation with ICSU, Rome, Italy (WMO-TD-Vol-1; GARP-Publ-27-Vol-1; ETN-87-99179) Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The Alpine Experiment; its data set and quality; lee cyclogenesis; and flow splitting and upstream blocking were discussed. For individual titles, see N87-21486 through N87-21516.

N87-21486# National Center for Atmospheric Research, Boulder, Colo.
THE AIM AND CONDUCT OF ALPEX
J. P. Kuettner *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 3-13 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The Alpine Experiment studied the influence of mountain ranges on atmospheric behavior, i.e., air flow, lee cyclogenesis, drag, and local wind circulations. Experiment design and management are described. ESA

N87-21487# Istituto di Fisica dell Atmosfera, Rome (Italy).
REVIEW OF THE WEATHER PHENOMENA OBSERVED DURING THE ALPINE EXPERIMENT (ALPEX) SPECIAL OBSERVING PERIOD
A. Buzzi *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 15-27 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The general meteorological conditions over the European-Atlantic sector during March-April, 1982 are reviewed. The evolution of the weather events during this period is examined, particularly cyclogenesis and other phenomena of interest to the Alpine Experiment (ALPEX). The ALPEX observing system is evaluated. ESA

N87-21488# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. for Atmospheric Physics.
ANALYSIS AND QUALITY OF ALPINE EXPERIMENT (ALPEX) DATA
Hans Richner *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 31-48 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The availability of Alpine Experiment (ALPEX) data is discussed and its quality is assessed. Quality varies considerably for different data types and it is difficult to locate some of the information and/or the documentation necessary to make full use of the data. Nevertheless, the ALPEX data set is unique in its nature; never before was data for a mountainous region available with such a high density in space and time which, despite all the errors it still contains, is checked so carefully. It is hoped that the quality of this data set is further investigated and made public to the scientific community, that the documentation is improved, and that the availability is increased by issuing more information on the location of special platform data. ESA

N87-21489# All-Union Scientific Research Inst. of Hydrometeorological Information, Moscow (USSR). Wold Data Center.
THE MEDITERRANEAN-ALPINE EXPERIMENT (MED-ALPEX) DATA SET
P. V. Nuzhdin and V. I. Melnikov *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 49-52 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Data on the interaction of the Mediterranean sea with the atmosphere and, in particular, the role of sea in the development of the atmospheric processes including those of cyclogenesis were collected. The data center compiled on magnetic tapes data from 2000 oceanographic stations in format GF-3. The data set contains information on temperature, salinity, and hydrochemical characteristics (oxygen, alkali, silicon, pH), from which can be determined detailed characteristics of hydrological fields and conditions of water mass, especially in the Adriatic Sea and the Algerian-Provencal basin. However, the incompleteness of data does not allow analysis of the seasonal variability of hydrological processes in a number of western and north-western areas of the Mediterranean. ESA

N87-21490# Innsbruck Univ. (Austria).
THE QUALITY OF THE ALPINE EXPERIMENT (ALPEX) 2B DATA SET WITH REGARD TO THE APPLICATION OF VORTICITY DYNAMICS
R. Steinacker *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 53-58 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The Alpine Experiment 2b data set was used to evaluate rawinsonde geopotential and wind data. Impact on the errors of the derived vorticity field is discussed. It is shown that beside a tremendous difference in quality between single stations, a lower limit of a meaningful vorticity computation even from high quality radar wind measurements lies at 100 km resolution. ESA

N87-21491# Oklahoma Univ., Norman. Cooperative Inst. for Mesoscale Meteorological Studies.
A VARIATIONAL OBJECTIVE ANALYSIS SCHEME FOR ANALYSIS OF THE ALPEX DATA SET
J. A. McGinley *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 59-72 (For primary document see N87-21485 14-47) (Grant NSF ATM-84-17654)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Analysis of the ALPEX 2-b data set is described. Using the calculus of variations in developing the analysis equations, considerations are consistent with requirements necessary for computing budgets for various meteorological quantities. One constraint which employs full equations of motion, reduces momentum residual to any desired level based on selection of a weighting function. Time tendencies are assumed to be observed while nonlinear terms can be observed or iterated. Mass continuity is completely imposed by application of a strong constraint. Approximation of terrain as a series of blocks in the x,y,p domain insures that the model terrain blocks the flow to the maximum extent possible in a way consistent with the Alpine range. Comparative analyses illustrate how coupling the variable increases resolution of fine scale features like fronts and jet maxima. Comparison with independently collected aircraft data over the Mediterranean Sea also shows how the scheme can provide improved analysis even over data sparse areas. Derived vertical motion fields compare well with middle and upper level cloud patterns for a case of rapid cyclogenesis. ESA

N87-21492# Institute for Meteorology and Water Economy, Cracow (Poland).
ACCURACY OF TEMPERATURE FIELDS AND LOCAL DATA SETS FOR THE TATRA MOUNTAINS (POLAND)
Barbara Braun and Tadeusz Niedzwiedz *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 73-84 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The estimation of air temperature accuracy and the status of a data base that was used to determine different climatic characteristics are discussed. The accuracy of air temperature is estimated by taking additional measurements and by optimal interpolation. The error field for temperature was calculated taking into account the distribution of reference (original) network of temperature measurements. Similar fields were also constructed for the upgraded network in which two observing stations were added. Inclusion of additional stations significantly improves the air temperature determination in the Tatra mountain region while the interpolated values derived from measurements at surrounding stations (reference case) contain large errors. ESA

N87-21493# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. for Atmospheric Physics.
RESULTS OF THE ALPINE EXPERIMENT (ALPEX) AIRCRAFT INTERCOMPARISON ON 19 APRIL 1982
Hans P. Fimpel and Hans Richner *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 85-94 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

During the Alpine Experiment Special Observing Period, three research aircraft flew an intercomparison flight over Lake Geneva. From the Level 2-b research aircraft data set with 1 sec resolution, the relative accuracies of position, height, static pressure, static temperature, dew point, and horizontal and vertical wind were calculated. The results are presented as mean differences and their standard deviations of the data of the three aircraft. ESA

N87-21494# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. for Atmospheric Physics.
VERTICAL AIR MOTION AND TURBULENCE PARAMETERS FROM COMMERCIAL AIRCRAFT c46
P. Gysel and H. Richner *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 95-105 Sponsored by the Swiss National Science Foundation (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The possibility of computing vertical air motion using data from wide-bodied commercial aircraft is discussed. The main problem is the quantization of the data originating in the aircraft integrated data system. Vertical winds with a low resolution (0.15 Hz) are computed which permit, e.g., the evaluation of lee waves. Higher frequency vertical motion is computed using the aircraft's vertical acceleration data. ESA

N87-21495# European Space Agency. European Space Operations Center, Darmstadt (West Germany).
METEOSAT CONTRIBUTION TO ALPINE EXPERIMENT (ALPEX): HIGHLIGHTS AND LIMITS
Maurizio Fea *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 107-118 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Meteosat-2 radiometer carried out frequent limited scans over the Alpine Experiment area during the Special Observing Period. Despite instrument problems and difficulties due to reorganization of the Meteosat ground segment, an archive of digital full resolution image data, 40 cm by 40 cm photographic negatives, and digital products (sea surface temperatures, cloud analysis, upper tropospheric humidity, climate data set) were obtained. ESA

N87-21496# National Oceanic and Atmospheric Administration, Madison, Wis. Systems Design and Applications Branch.
MULTIVARIATE ANALYSES OF ALPEX SATELLITE RETRIEVALS
W. P. Menzel, G. A. Mills, A. J. Schreiner, C. M. Hayden, and W. L. Smith *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 119-130 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Analyses of high resolution temperature and humidity profiles retrieved from polar orbiting sounding satellites and in situ profile data gathered during the ALPEX Intensive Observing Period are compared. The retrieval technique is the simultaneous physical solution for temperature and water vapor profiles. The analysis scheme is multivariate. The moisture analysis is compared with Meteosat water vapor images to investigate the horizontal resolving power of the satellite sounding data acquired during ALPEX. The study demonstrates that the TOVS data contain moisture information of good quality at high horizontal resolution that should impact numerical forecasts positively. ESA

N87-21497# Istituto di Fisica dell Atmosfera, Rome (Italy).
REMOTELY SENSED SEA SURFACE TEMPERATURE FOR THE ALPINE EXPERIMENT (ALPEX) **c48**
G. Dalu, A. Viola, and S. Marullo *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 131-138 Sponsored by CNR (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The methodology behind the algorithms used to retrieve the sea surface temperature from infrared radiometric data was examined with a radiative transfer model that simulates the response of the atmosphere for different temperature and water vapor profiles. Linear algorithms are used to evaluate the sea surface temperature from AVHRR data. Although the results obtained show that a nonlinear algorithm is more accurate, a linear algorithm can give better results if it is optimized for a particular region and season. An improved calibration procedure was used to process the data of the AVHRR-2 radiometer. ESA

N87-21498# Belgrade Univ. (Yugoslavia).
ALPINE LEE CYCLOGENESIS: NUMERICAL SIMULATION AND THEORY
Fedor Mesinger and Raymond T. Pierrehumbert *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p. 141-163 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Achievements in numerical modeling of the Alpine lee cyclogenesis are reviewed. The theoretical issues relating to lee cyclogenesis are discussed, and approaches are reviewed. A consensus is emerging that the essence of lee cyclogenesis resides in orographic modification of large scale baroclinic instability. Considerable success is achieved in understanding various aspects of the phenomenon in isolation, but a complete, quantitive theoretical model is not available. ESA

N87-21499# Istituto di Fisica dell Atmosfera, Rome (Italy).
A THEORY OF DEEP CYCLOGENESIS IN THE LEE OF THE ALPS: MODIFICATION OF BAROCLINIC INSTABILITY BY TOPOGRAPHY
A. Speranza, A. Buzzi, A. Trevisan, and P. Malguzzi *In* WMO Proceedings of the Conference of the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 165-174 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

A theory modeling Alpine cyclogenesis in terms of orographically modified normal modes of the baroclinic instability of a zonal flow is proposed. It is shown how the free unstable modes growing on a baroclinic zonal wind are modified by a small (perturbative) mountain extending in the east-west direction in a quasigeostrophic atmosphere. Such modification is antisymmetric with respect to the mountain crest; in the case of limited mountain it essentially consists of a high-low dipole bound to the mountain, extending throughout the troposphere and having a horizontal scale comparable to the Rossby radius of deformation. There are two limitations to the theory: the Alps are not small, and their horizontal scale is too short for the quasigeostrophic theory to be consistent. ESA

N87-21500# Istituto di Fisica dell Atmosfera, Rome (Italy).
THE MECHANISMS OF OROGRAPHIC CYCLOGENESIS
A. Speranza, A. Buzzi, S. Tibaldi, and E. Tosi *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 175-186 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Cyclogenesis near the Rockies and the Himalayas is examined in the light of a theoretical model concerning the interaction of baroclinic transients with local orography. Analysis of different types of topographic cyclogenesis supports the idea that the basic mechanism is baroclinic conversion in the presence of orography. Since the general circulation conditions and the geometrical shape of the bottom boundary are very different for different cyclogenesis types, specific analysis is required for each. ESA

N87-21501# Istituto di Fisica dell Atmosfera, Rome (Italy).
A NORMAL MODE NONGEOSTROPHIC MODEL OF LEE CYCLOGENESIS
P. Malguzzi and A. Trevisan *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 187-193 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Baroclinic instability in the presence of steep, finite amplitude topography is studied in the primitive equation model. The quasigeostrophic theory of Alpine cyclogenesis of Speranza et. al. (1985) is reanalyzed. It turns out that the use of primitive equation is necessary to reproduce the correct topographic effects. ESA

N87-21502# National Meteorological Inst., Madrid (Spain).
SPANISH LIMITED AREA MODEL (LAM) BEHAVIOR IN TWO CASES OF MEDITERRANEAN CYCLOGENESIS
M. Hortal, A. Jansa, and C. Gimeno *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 195-206 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The Spanish limited area model (LAM), a version of the model ECMWF, was adapted for use in operational forecasting for Spain with a resolution of 0.91 deg longitude and latitude. It was applied to two cases of cyclogenesis observed during the Special Observing Period (SOP) of ALPEX, starting from the operational initialized analysis of ECMWF, which data were interpolated bilinearly in the horizontal to the model grid. The LAM uses a sigma coordinate with a mean orography. In order to study the influence of the orography on cyclogenesis, simulations were made with change of the height of the Pyrenees, the Alps, the Iberian peninsula, and the Atlas mountains. The influence of the other physical processes was studied by changing the roughness length in the area of the Alps and the sea surface temperature of the Mediterranean Sea. Results were compared with a similar study using the operational ECMWF orography which changes during the first forecast steps towards the fine resolution. ESA

N87-21503# European Centre for Medium-Range Weather Forecasts, Reading (England).
REPRESENTATION OF PRESSURE DRAG EFFECTS IN NUMERICAL MODELING OF ALPINE CYCLOGENESIS
S. Tibaldi and L. DellOsso *In* WMO Proceedings of the Conference

on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 207-214 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Two microbarographic arrays set up across the Alpine range during the Alpine Experiment Special Observation Period were used to investigate whether numerical atmospheric models produce realistic pressure drag values and how these values depend upon the model's resolution and orography specification. Two sets of ECMWF grid-point limited area model integrations are described. Results show that models can produce mountain generated pressure drags of the right magnitude and that the effects of resolution appear to work in the right direction. Pressure drag is shown to be a useful diagnostic tool to assess quantitatively the ability of models to reproduce accurately the timing of the onset of lee cyclogenesis. ESA

N87-21504# Technische Univ., Munich (West Germany). Working Group for Theoretical Meteorology.
NUMERICAL SIMULATION OF LEE CYCLOGENESIS DURING ALPINE EXPERIMENT WITH AN ISENTROPIC COORDINATE MODEL
A. Tafferner *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 215-230 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Numerical simulations of three cases of Alpine lee cyclogenesis were carried out using an isentropic coordinate model developed by Bleck (1984). Two dynamical effects, i.e., the advection of potential vorticity by a penetrating jet streak in the upper troposphere and advection of cold air at low levels can be traced during the model simulations and seem to play an important role for the cyclonic developement in the lee of the Alps. ESA

N87-21505# Direction de la Meteorologie Nationale, Paris (France).
THE ROLE OF ALPS MOUNTAINS REPRESENTATION IN THE LEE CYCLOGENESIS SIMULATION
H. L. Pham *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 231-241 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Six cases of lee cyclogenesis were chosen for numerical simulations. Experiments show that the development of a cyclone starts with 6hr delay if mountains are excluded. Such a cyclone also moves more quickly to a wrong position. Using the so-called RM orography obtained by averaging the values of the 10'x10' resolution orography data set, the cyclone was predicted at the right place and local phenomena (such as Bora, North Foehn, Tramontana) were simulated correctly. The prediction of the lee cyclogenesis was made with various representations of the mountains from 4 March at 00 GMT to 5 March at 12 GMT. The different orographies were: RM, RE (envelope orography) and RM with different degrees of smoothing. It is found that local phenomena are better simulated with RM but the cyclone which first developed over Nice reached the Mediterranean Sea only 12hr later and stopped moving west of Corsica whatever the orography was used. ESA

N87-21506# Innsbruck Univ. (Austria). Space Science and Engineering Center.
ON THE SYNOPTICS AND DYNAMICS OF OROGRAPHICALLY INDUCED CYCLONES IN THE MEDITERRANEAN
H. Pichler and R. Steinacker *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 245-250 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

All cases of orographically induced cyclogenesis in the Western Mediterranean during the whole ALPEX observation period were investigated statistically to find special types of such cyclogeneses. It can be shown that there exist two different types of orographically induced cyclogenesis in the Western Mediterranean: the Vorderseiten type and the Uberstromungs type. Both types are accompanied by low level blocking of cold air due to the Alps. Case studies during the Special Observation Period were used to investigate the relevance of the convergence of the horizontal vorticity flux and the transformation of shear vorticity into curvature vorticity during such cyclogenetic processes, using analysis in isentropic coordinates. ESA

N87-21507# Wisconsin Univ., Madison. Space Science and Engineering Center.
QUASI-LAGRANGIAN DIAGNOSTICS OF A MEDITERRANEAN CYCLONE: ISENTROPIC RESULTS
Donald R. Johnson and David K. Hill *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 251-264 (For primary document see N87-21485 14-47)
(Grant NSF ATM-81-10678)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

A quasi-Lagrangian diagnostic analysis of a Mediterranean cyclone was performed to study the mass and angular momentum balance of this cyclone and to compare the results with the diagnostic results from other cyclones from different geographical regions. The agreement between the sense of the mass circulation and the torques distribution reveals that the Mediterranean cyclone was strongly coupled with the larger scale during its period of maximum development and that baroclinic processes through pressure and inertial torques as well as the convergence of eddy angular momentum transport play a key role. Latent heat release and its vertical transport of angular momentum increase in importance after the initial development. The overall structure of development processes within this Mediterranean cyclone are similar to the structure of moist baroclinic development within cyclones over the continental United States, at least in the later time periods when a two layer circulation becomes established. During the period of maximum development, however, substantial differences occur. ESA

N87-21508# Oklahoma Univ., Norman. Cooperative Inst. for Mesoscale Meteorological Studies.
VORTICITY BUDGETS FOR ALPINE CYCLOGENESIS WITH AND WITHOUT THE FORCING OF TERRAIN
J. A. McGinley *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 265-280 (For primary document see N87-21485 14-47)
(Grant NSF ATM-84-17654)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Three cases of Alpine cyclogenesis are examined. All had similar initiating conditions with northwesterly flow, an upstream short wave, and jet streak. Using the ALPEX 2-b data set, objective analyses were performed and vorticity budget computations made. In each case, vorticity tendencies in a quasi-Lagrangian volume moving with the surface disturbance, are dominated by vorticity advection aloft and convergence of Earth vorticity at low levels. A second series of budgets produced from fields derived in a no mountain environment and then subtracted from the mountain budgets, indicate that the major effect of mountains is to increase differential vorticity advection and low level vorticity convergence up to 625 hPa. However, mountains reduce vorticity in these same layers. ESA

N87-21509# Freie Univ., Berlin (West Germany).
FINE MESH ANALYSIS OF GENOA CYCLOGENESIS BY USE OF ISENTROPIC COORDINATES
E. Reimer *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 281-296 (For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva,

Switzerland

A statistical scheme on isentropic surfaces as used for quantitative determination of energy and kinematic budgets was developed for mountain area cyclogenesis studies. When analyzing fine scale features problems arise because the observations are too widespread and the correlation functions are not generally defined at small lags. Moreover, the geostrophic relationship is only appropriate in relation to broad scales. The scheme overcomes these problems by dividing the analysis procedure into a broad-scale part and a fine-mesh correction. Potential temperature is chosen as vertical coordinate, because it promises a more favorable vertical resolution than other coordinates. Vertical resolution varies with local stability of temperature, so that special features (like fronts) are represented in a more adequate manner. The operational analysis from ECMWF is used as first guess. Ageostropic motions in relation to geostrophic motions are diagnosed and potential vorticity is used to demonstrate the strong ageostrophic wind near the Alps during cyclogenesis. ESA

N87-21510# National Meteorological Inst., Madrid (Spain). Centro Meteorologico Zonal de Palma de Mallorca.

NONALPINE CONTRIBUTION TO MEDITERRANEAN CYCLOGENESIS: SYNOPTIC STUDY OF TWO CASES WHICH OCCURRED DURING ALPINE EXPERIMENT (ALPEX) SPECIAL OBSERVING PERIOD

A. Jansa, S. Alonso, C. Ramis, M. A. Heredia, and J. A. Garcia-Moya *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 297-308 (For primary document see N87-21485 14-47)

Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

A pre-Alpine, although Mediterranean, stage of lee cyclogenesis was studied via manual analysis and objective analysis of Alpine Experiment data. It's shown that a subtropical perturbation, that interacts with a polar one, leads to a Mediterranean cyclone. The process can be seen as a result of baroclinic instability. Initially the orography and the coastal line and, perhaps, the humidity from the Mediterranean and the heat from the desert seem to be factors acting on the intensity and location of the perturbation. ESA

N87-21511# Bonn Univ. (West Germany). Inst. fuer Meteorologie.

SYNOPTIC 3D ENERGY BUDGETS DURING ALPINE EXPERIMENT SPECIAL OBSERVING PERIOD (ALPEX-SOP)

M. Hantel and S. Emeis *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 309-317 Sponsored by the Deutsches Forschungsgemeinschaft (For primary document see N87-21485 14-47)

Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Results of a diagnostic model that estimates the subsynoptic (unobserved) vertical eddy fluxes of sensible heat, latent heat, and rain in the free atmosphere as residuals plus errors from complete synoptic budgets are presented. The atmosphere over Europe is divided into equal area columns, each column into equal mass boxes; budgets are calculated for each box. Results for 5 March 1982 with a final resolution of 100 km horizontally and 100 hPa vertically are presented. They demonstrate that the three subsynoptic vertical fluxes are important parts of the heat budgets and that they fit well into the synoptic situation. ESA

N87-21512# Cologne Univ. (West Germany). Inst. fuer Geophysik.

COMPARATIVE STUDY OF SEVERAL CASES OF ALPINE LEE-CYCLOGENESIS: KINETIC ENERGY AND VORTICITY

G. Frenzen and P. Speth *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 319-337 (For primary document see N87-21485 14-47)

Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

For five cases of Alpine lee-cyclogenesis during Alpine Experiment Special Observing Period, the terms of the budget equations of kinetic energy and of vorticity are calculated in order to deduce analogies in the developments of the different lee-cyclones. The derived results suggest a number of analogies, e.g., the orographic influence on low-level vorticity and the advection of vorticity into the developing cyclone. Nevertheless numerous differences are found too, especially in the upper air energetics. ESA

N87-21513# European Centre for Medium-Range Weather Forecasts, Reading (England).

WEATHER REGIMES AND MOUNTAIN EFFECTS IN GENERAL CIRCULATION MODELS: IMPLICATIONS FOR EXTENDED RANGE WEATHER FORECASTS

S. Tibaldi *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 341-358 (For primary document see N87-21485 14-47)

Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The role played by the Earth's orography in producing weather regimes is examined and the implications for climatology are commented upon. The relationship between general circulation model systematic errors and the representation of orography is shown and general properties of the technique of orographic enhancement are mentioned. Outstanding questions related to the concepts introduced are posed, and the relevance of such questions to the problem of extended range weather forecasting is underlined. ESA

N87-21514# Istituto di Fisica dell Atmosfera, Rome (Italy).

STRATIFIED FLOW AND WAVE MOTION NEAR MOUNTAIN TOPS **c46**

F. Tampieri and J. C. R. Hunt *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 359-369 (For primary document see N87-21485 14-47)

Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Features of stably stratified flows over obstacles are considered, on the basis of laboratory visualization experiments and theoretical results. The cut-off hill model for isolated obstacles in strongly stratified flows, the structure of the upstream low-velocity region, and the valley separation are discussed. A comparison with data taken in the real atmosphere is presented. ESA

N87-21515# Oklahoma Univ., Norman. Cooperative Inst. for Mesoscale Meteorological Studies.

EFFECTS OF TERRAIN HEIGHT AND BLOCKING INITIALIZATION ON NUMERICAL SIMULATION OF ALPINE LEE CYCLOGENESIS

J. A. McGinley and J. S. Goerss *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 371-390 (For primary document see N87-21485 14-47)

(Grant NSF ATM-84-17654)

Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Numerical experiments were performed to test the evolution of lee cyclones with various terrain representations, and to test forecast sensitivity to initial wind fields. Using the data set collected during the operational phase of the ALPEX field experiment, a mesoscale model was initialized with data from two markedly different cases, 12 hr prior to formation of a cyclone in the Mediterranean. The terrain used ranged from flat, sea level terrain, to orography that conserved the maximum barrier height of the Alps (similar to envelope terrain currently used at the ECMWF). Results show that even in the 12 hr period preceding cyclogenesis the mountain plays a crucial role in the evolution of the cyclone. Sharp variation in position and strength is evident depending on the terrain employed. Comparisons of terrain versus no-terrain cases show perturbations that compare well with those proposed by theory. ESA

N87-21516# Wyoming Univ., Laramie. Dept. of Mechanical Engineering.
LABORATORY SIMULATION OF ROTATING STRATIFIED FLOW OVER AND AROUND THE ALPS **c46**
Don L. Boyer, Ruirong Chen, and Peter A. Davies *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 391-404 (For primary document see N87-21485 14-47)
(Grants NSF ATM-80-18173; NSF ATM-82-18488)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

A linearly salt-stratified rotating water channel was used to simulate the dynamical effects of the flow over and around a model Alpine-Pyrenees topography. Experiments with zonal westerly currents indicate eddy shedding in the lee. Measurements of the Strouhal number as a function of Rossby number for a fixed Ekman and Burger number and for a fixed topography height to fluid depth ratio are presented. It is shown that flow splitting for westerly and northwesterly flow occurs in the vicinity of Geneva. Experiments demonstrate the conditions under which lee waves should be expected for westerly and for northwesterly flow. It is shown that advection of a parent cyclone from west to east along a path north of the Alps can generate a cyclone in the lower levels of the atmosphere in or near the Gulf of Genoa. It is suggested that these mechanical effects may play a role in triggering a lee cyclone which then might grow by other physical processes. ESA

N87-21517# Naval Research Lab., Washington, D. C.
TETHERED BALLOON MEASUREMENTS MADE AT NAVAL AIR DEVELOPMENT CENTER (DECEMBER 1985) Interim Report
W. P. Hooper and H. Gerber 29 Dec. 1986 98 p
(AD-A176254; NRL-MR-5893) Avail: NTIS HC A05/MF A01 CSCL 04/2

For six daylight periods, a meteorological package attached to a tethered balloon and radiosondes measured water vapor profiles at the Naval Air Development Center, Warminster, Pa. for comparison with water vapor profiles made by a solar blind Raman laser radar (lidar). This report discusses the water vapor, temperature, scattering coefficient, and ozone profiles made with the meteorological package which was built from in situ dry bulb temperature, wet bulb temperature, and pressure. A nephelometer with a photopic response measured the scattering coefficient. The ozone measurements were made with an electrochemical concentration cell in a soned, loaned from the NOAA Laboratory in Boulder, Co. A 53-foot aerostat balloon carried the NRL package from the surface to 800 m. During the test period, stable and well-mixed boundary layers were observed. A warm front was profiled on the last day of the experiment. GRA

N87-21518# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THUNDERSTORM INFLUENCE ON BOUNDARY LAYER WINDS M.S. Thesis
Jill M. Schmidt Dec. 1986 49 p
(AD-A176543; AFIT/CI/NR/87-5T) Avail: NTIS HC A03/MF A01 CSCL 04/1

The objective is to develop a conceptual model of selected pre-storm ambient conditions as a function of the strength of a thunderstorm's outflow. The time of maximum rainfall in relation to the time of maximum outflow was a thunderstorm characteristic which helped explain the downdraft mechanism and was included in the model. The results indicated that two conceptual models were necessary to describe the pre-storm ambient conditions that led to thunderstorm development and outflow. One model contained the weaker outflows and the other described the stronger outflows. Six significant ambient conditions contributed to the thunderstorm building process, i.e., (1) horizontal moisture convergence below cloud base, (2) vertical flux divergence of latent heat energy below cloud base, (3) vertical wind shear in the 850 mb to 300 mb layer, (4) an environmental lapse rate approaching dry adiabatic at least in the lower subcloud layer, (5) potential instability below cloud base and, (6) potential evaporative cooling below cloud base. The model for the weaker outflows had relatively small magnitudes of ambient conditions, while the model for the stronger outflows had relatively large magnitudes of ambient conditions. GRA

N87-21519# Naval Postgraduate School, Monterey, Calif.
CHARACTERISTICS OF MESOSCALE ISLAND BARRIER CLOUD PHENOMENA OBSERVED IN SATELLITE AND SPACE SHUTTLE IMAGERY M.S. Thesis
David R. Markley, Jr. Dec. 1986 61 p
(AD-A176628) Avail: NTIS HC A04/MF A01 CSCL 04/1

Mesoscale island barrier effects occur in the lee of islands and are observed in satellite imagery and in photographs from manned spaceflight missions. These phenomena arise when, in the presence of a low-level inversion, the boundary layer flow is disturbed by a barrier. Five types of island barrier effects are examined: (1) von Karman vortices, (2) single plumes, (3) transitions from vortices to plumes, (4) calmsea streaks, and (5) ship wake-like cloud patterns. Results from 23 cases indicate a strong relationship between inversion height and type of barrier effect phenomena. A low, strong inversion was found for von Karman vortices cases while a higher, weaker inversion was present in the transition and plume cases. An inversion above the barrier occurred with wake phenomena. Wind shear structure appears important in the development of the calm sea streaks and the ship wake patterns. GRA

N87-21520# World Climate Programme, Geneva (Switzerland).
NOCTURAL TOPOCLIMATOLOGY
L. Mahrt (Oregon State Univ., Corvallis) Jun. 1986 89 p
(WCP-117; WMO-TD-132; ETN-87-99181) Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

Cold air drainage and the influence of such flows on local microclimates are reviewed. The dynamics of downslope drainage flows are presented. The behavior of turbulence in stratified flow is described. The most important influence on strong nocturnal surface cooling is the development of intermittent turbulence and associated downward heat flux. The problem of complex irregular terrain is treated phenomenologically. Complications due to the vegetation canopy are considered. The difficulty of obtaining representative surface measurements in complex terrain under conditions of strong nocturnal cooling is noted. Implications for numerical modeling are mentioned. ESA

N87-21521# World Climate Programme, Geneva (Switzerland).
REPORT OF THE WORKSHOP ON ASSIMILATION OF SATELLITE WIND AND WAVE DATA IN NUMERICAL WEATHER AND WAVE PREDICTION MODELS
Sep. 1986 69 p Workshop held in Shinfield Park, England, 25-26 Mar. 1986 Prepared in cooperation with ICSU, Rome, Italy (WCP-122; WMO-TD-148; ETN-87-99183) Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The assimilation of microwave data in atmospheric and wave models, and the relation between on-line data assimilation systems and quick-look and off-line analysis facilities were discussed. The assimilation system should provide gridded data of surface winds, surface stresses, surface fluxes of sensible and latent heat, and surface waves, using all the sensor data of oceanographic satellites with all other available conventional and (meteorological) satellite data. The generation of a multiyear, continuous time sequence of gridded surface stress and heat flux fields is essential for climatological studies. Since the data assimilation requirements of climate and forecasting applications are essentially identical, and most of the required data are routinely collected at forecasting centers, it is practical to implement the data assimilation system at global weather forecasting centers. Numerical experiments which can be carried out with SEASAT data to develop and test integrated data assimilation methods were identified. ESA

N87-21522# Royal Netherlands Meteorological Inst., De Bilt.
SNOW DEPTHS IN THE NETHERLANDS FROM MEASUREMENTS AT SYNOPTIC STATIONS IN 1955 AND IN THE PERIOD 1978-1984 [SNEEUWDEK HOOGTEN IN NEDERLAND NAAR METINGEN VAN DE SYNOPTISCHE STATIONS IN 1955 EN

1978-1984]
J. vanderHorst 1986 62 p In DUTCH; ENGLISH summary
Supplement to KNMI-TR-51
(KNMI-TR-51a; KNMI-TR-51; B8669672; ISSN-0169-1708; ETN-87-99265) Avail: NTIS HC A04/MF A01

Observations of snow depths were performed to complete a full climatological period of 30 yr. Climatological data for the period 1955 to 1984 are presented. ESA

N87-21523# Royal Netherlands Meteorological Inst., De Bilt. Afdeling Fysische Meteorologie.
DESCRIPTION OF THE TERSCHELLING WIND OBSERVATION STATION FOR THE PERIOD 1949-1980
B. Oemraw 1986 40 p In DUTCH; ENGLISH summary
(KNMI-TR-86; B8668451; ISSN-0169-1708; ETN-87-99269) Avail: NTIS HC A03/MF A01

The wind observations of a synoptic weather station were evaluated. It is concluded that the wind data (after correction for sheltering effects) are reasonably dependable and homogeneous from August 1968 onwards, when the anemometer was relocated at a very open position. The corrected wind data above open terrain for the period 1969-1980 are summarized. The tables cover the diurnal and annual course, various frequency distributions, and for each two-month season the largest observed values of the hourly-average wind speed per 30 deg azimuthal sector. ESA

N87-21524# Royal Netherlands Meteorological Inst., De Bilt. Afdeling Fysische Meteorologie.
THE ATMOSPHERIC BOUNDARY LAYERS [DE ATMOSFERISCHE GRENSLAAG]
J. Wieringa 1986 87 p In DUTCH
(KNMI-TR-89; B8679722; ISSN-0169-1708; ETN-87-99272) Avail: NTIS HC A05/MF A01

The status of knowledge in the field of the atmospheric boundary layer is reviewed. The choice of characteristic boundary layer parameters is discussed. The similarity model of the adiabatic boundary layer is presented. The utility of exchange coefficients is explained. The modeling of the surface layer is discussed. The behavior of diabatic planetary boundary layers is explained. The atmospheric transport of admixtures and the boundary layer treatment in large scale models are discussed. ESA

N87-21525# Research Inst. of National Defence, Linkoeping (Sweden). Dept. 3.
MICROWAVE MEASUREMENTS OF SNOW IN DAVOS (SWITZERLAND), MAY-JUNE 1986
Christian Maetzler and Ain Sume Dec. 1986 83 p Sponsored by the Swedish Material Administration of the Armed Forces
(FOA-C-30437-3.2; ISSN-0347-3708; ETN-87-99774) Avail: NTIS HC A05/MF A01; Research Institute of National Defence, Stockholm, Sweden KR50

Measurements of snow were made with a sensor package consisting of radiometers at 4.9, 10.4, 21, 35, and 94 GHz and a scatterometer at 10.4 GHz from a 14.5 m tower. In the passive measurements the brightness temperature of the snow at 50 deg nadir angle was recorded for horizontal and vertical polarization. With the scatterometer the transmitted and received power was used to calculate the backscattering coefficient versus nadir angle for vertical polarization. The dielectric properties of the snow were derived with Fresnel's reflection formula and assuming a Debye-type relaxation spectrum. Comparison with resonance measurements with cavities inserted into the snow is made. Liquid water content is calculated from the dielectric properties and the diurnal variations were monitored. At night a crust, formed on top of the melting snow-pack, displays characteristic differences compared to wet snow. ESA

N87-21526# National Oceanographic Data Center, Washington, D. C.
MARINERS WEATHER LOG, VOLUME 30, NUMBER 4, FALL 1986
1986 75 p
(PB87-129417) Avail: NTIS HC A04/MF A01 CSCL 04B

Topics addressed include: effect of freak waves on the Polar Sea; weather and maritime casualties; western North Pacific typhoons (1985); marine observations program; changes to marine weather broadcasts; and marine weather review. B.G.

N87-21527# National Severe Storms Forecast Center, Kansas City, Mo.
VERIFICATION OF SEVERE LOCAL STORM FORECASTS ISSUED BY THE NATIONAL SEVERE STORMS FORECAST CENTER, 1985
P. W. Leftwich Nov. 1986 16 p
(PB87-137139; NOAA-TM-NWS-NSSFC-13) Avail: NTIS HC A02/MF A01 CSCL 04B

The SELS Unit of the National Severe Storms Forecast Center routinely issues convective outlooks and severe local storm watches that delineate areas that are favorable for development of severe local storms. The report summarizes verification of those forecasts that were issued during 1985. Convective outlooks exhibited the best forecast skill during the active months of spring. Ability in delineating the threat of tornadoes by tornado watches was observed. High percentages of tornado-related fatalities (83%) and injuries (76%) occurred within valid severe local storm watches. Greater skill was shown in forecasting the more intense tornadoes. GRA

N87-21528# National Severe Storms Forecast Center, Kansas City, Mo.
SEVERE LOCAL STORM WARNING VERIFICATION: 1985
P. W. Leftwich and L. A. Grenier Dec. 1986 23 p
(PB87-137147; NOAA-TM-NWS-NSSFC-14) Avail: NTIS HC A02/MF A01 CSCL 04B

Tornado and severe thunderstorm warnings are issued by local offices of the National Weather Service. The report highlights verification procedures and summarizes national, regional and local verification results for the year 1985. Stations in the Central and Southern regions again issued most of the warnings and experienced most of the severe local storm events. GRA

N87-21529# Washington Univ., St. Louis, Mo. Center for Air Pollution Impact and Trend Analysis.
HAZE CLIMATE OF THE UNITED STATES Final Report
R. B. Husar and D. E. Patterson Dec. 1986 102 p
(Grant EPA-R-180351)
(PB87-141057; EPA/600/3-86/071) Avail: NTIS HC A06/MF A01 CSCL 04B

The historical data base of visual range at 137 surface synoptic meteorological stations is examined. The original observations of visual range each noon are converted to light extinction coefficient, BEXT = 24/VISIBILITY, a measure of haziness. The best is summarized for each calendar quarter from 1948 to 1963 as percentiles of the distribution function, namely the 25th, 50th (median), 75th and 90th percentile. Detailed examination of station by station behavior indicate that the median is often obscured by an upper threshold of visual range reported. The results consist of trend graphs, as well as seasonal contour maps for each decade of the time period. GRA

N87-21530# National Center for Atmospheric Research, Boulder, Colo.
BIOSPHERE-ATMOSPHERE TRANSFER SCHEME (BATS) FOR THE NCAR (NATIONAL CENTER FOR ATMOSPHERIC RESEARCH) COMMUNITY CLIMATE MODEL
R. E. Dickinson, A. Henderson-Sellers, P. J. Kennedy, and M. F. Wilson Dec. 1986 81 p
(Grant NSF ATM-82-17015)
(PB87-141511; NCAR/TN-275+STR) Avail: NTIS HC A05/MF A01 CSCL 04B

Since early 1977, various members of the Atmospheric Analysis and Prediction Division at NCAR and other collaborators have been developing a comprehensive model of land-surface processes suitable for use, initially with the previous grid-point General Circulation Model, and now with the spectral Community Climate Models. Special emphasis has been given to describing properly

the role of vegetation in modifying the surface moisture and energy budgets. The result of these efforts has been incorporated into a boundary package, referred to as the Biosphere-Atmosphere Transfer Scheme-a piece of software of about three thousand lines of code written in SI units that runs as an offline version or coupled to the CCM. The purpose of the report is to describe the physical processes, current numerical parameterizations, and some of the code structure of the boundary package. GRA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N87-21531 Chesapeake Research Consortium, Inc., Gloucester Point, Va.
MARINE ENVIRONMENTAL ASSESSMENT: CHESAPEAKE BAY, DECEMBER 1985 - FEBRUARY 1986
K. L. Kelly, T. L. Bashore, and K. L. McDonald 1986 40 p
(Contract NA85AA-D-SG016)
(PB87-129458; CRC-PUB-122; VSG-86-03A; ISSN-0083-6443) Copyright. Avail: NTIS HC A03/MF A01; Also Avail: The Chesapeake Research Consortium, Inc., P.O. Box 1120, Gloucester Point, Va. 23062 CSCL 08C

Topics addressed include: highlights in general events and impacts; weather and oceanography summary (weather, bay ice cover, streamflow, oceanography); and impact of climate and weather (fisheries, recreation, transportation). GRA

N87-21532# Woods Hole Oceanographic Institution, Mass.
ABSTRACTS OF PAPERS SUBMITTED IN 1985 FOR PUBLICATION (FOR WOODS HOLE OCEANOGRAPHIC INSTITUTION)
A. I. Rabushka 1986 157 p
(PB87-129433; WHOI-86-2) Avail: NTIS HC A08/MF A01 CSCL 08C

Abstracts submitted for publication during calender year 1985 by the staff and students of the Wood Hole Oceanographic Institution are presented. Because some of the abstracts may not be published in the journal to which they have been submitted initially, the authors have purposely omitted identifying the journals. The volume is intended to be informative, but not a bibliography. The abstracts are listed by title and are grouped into one of the five departments, marine policy, or the student category. Author

N87-21533*# Wisconsin Univ., Madison. Space Science and Engineering Center.
QUICK LOOK ATLANTIC OCEAN RAIN MAPS FOR GALE Interim Report
David W. Martin and Brian Auvine Mar. 1987 32 p
(Grant NAG5-742)
(NASA-CR-180511; NAS 1.26:180511) Avail: NTIS HC A03/MF A01 CSCL 08C

A set of quick look maps of Atlantic Ocean rainfall were made. The maps are based entirely on information extracted from geostationary satellite images. The maps and the process by which they were made are briefly described. The major shortcomings of such a project are pointed out. For convenience the maps are presented in rectangular format. Each map covers one day. Rainfall is contoured in units of millimeters. Rainfall was estimated by the Arkin technique. B.G.

N87-21534*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIDAL ESTIMATION IN THE ATLANTIC AND INDIAN OCEANS, 3 DEG X 3 DEG SOLUTION
Braulio V. Sanchez, Desiraju B. Rao (National Oceanic and Atmospheric Administration, Rockville, Md.), and Stephen D. Steenrod (Applied Research Corp., Landover, Md.) Apr. 1987 21 p
(NASA-TM-87812; Rept-87B0163; NAS 1.15:87812) Avail: NTIS HC A02/MF A01 CSCL 08C

An estimation technique was developed to extrapolate tidal amplitudes and phases over entire ocean basins using existing gauge data and the altimetric measurements provided by satellite oceanography. The technique was previously tested. Some results obtained by using a 3 deg by 3 deg grid are presented. The functions used in the interpolation are the eigenfunctions of the velocity (Proudman functions) which are computed numerically from a knowledge of the basin's bottom topography, the horizontal plan form and the necessary boundary conditions. These functions are characteristic of the particular basin. The gravitational normal modes of the basin are computed as part of the investigation; they are used to obtain the theoretical forced solutions for the tidal constituents. The latter can provide the simulated data for the testing of the method and serve as a guide in choosing the most energetic functions for the interpolation. Author

N87-21535# Naval Postgraduate School, Monterey, Calif.
DATA FROM THE OPTICAL DYNAMICS EXPERIMENT (ODEX) R/V ACANIA EXPEDITION OF 10 OCTOBER THRU 17 NOVEMBER 1982. VOLUME 1: CTD AND OPTICS PROFILES (TEMPERATURE, SALINITY, DENSITY, SOUND SPEED, OPTICAL BEAM ATTENUATION, FLUORESCENCE, AND DISSOLVED OXYGEN) Progress Report, Oct. 1982 - Dec. 1986
James A. Stockel, James L. Mueller, Hasong Pak, and David Menzies 30 Dec. 1986 270 p
(AD-A176289; NPS-68-86-013-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 08/10

Between 10 October and 17 November 1982, the R/V Acania occupied 184 scientific stations in the eastern N. Pacific Ocean to observe spatial variability in optical, physical, biological and chemical properties of sea water. This expedition was part of the Optical Dynamics Experiment (ODEX). The experimental objective of ODEX is to characterize vertical distributions of optical properties in the open ocean, and their associations with vertical distributions of temperature, salinity, density, phytoplankton pigment concentrations, nutrient concentrations, and primary productivity: these are the ingredients needed to initialize and test 1-dimensional model predictions of changes in vertical optical propagation in response to atmospheric and radiation forcing of the upper ocean. GRA

N87-21536# Texas Univ., Austin. Applied Research Lab.
ON THE SPATIAL STRUCTURE OF THE ACOUSTIC SIGNAL FIELD NEAR THE DEEP OCEAN BOTTOM DUE TO A NEAR-SURFACE cw SOURCE
David E. Grant 4 Nov. 1986 163 p
(Contract N00024-86-C-6134)
(AD-A176344; ARL-TR-86-34) Avail: NTIS HC A08/MF A01 CSCL 17/1

The spatial structure of the acoustic signal field near the ocean bottom was investigated experimentally. A source near the ocean surface projected a cw tone as it moved along a radial path from a range of 40 km to within 2 km of a near-bottom vertical array of receiving hydrophones in a 2643 m deep ocean. The signal level at each hydrophone and the signal phase difference between consecutive pairs of hydrophones were measured as a function of source-receiver range. A technique for modeling the signal field spatial structure was developed that demonstrated those physical mechanisms that influence the signal field. It was found that, for short ranges, signal phase difference was dominated by a few eigenrays and that coherent interference among these rays was an important factor in describing certain aspects of the signal field. An application to receiving array beamforming was made in which it was shown that inhomogeneities in the spatial structure of the signal field lead to degradation of array signal gain when standard delay-and-sum beamforming was done. GRA

N87-21537# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
EFFECTS OF ATMOSPHERIC WATER VAPOR ON THE DETECTION OF MESOSCALE OCEANOGRAPHIC FEATURES FROM GEOSAT Final Report
Jeffrey D. Hawkins and Peter M. Smith Nov. 1986 26 p

(AD-A176365; NORDA-126) Avail: NTIS HC A03/MF A01 CSCL 08/3

The GEOSAT Ocean Applications Programs (GOAP) uses near-real-time altimeter data to map mesoscale fronts and eddies in the Gulf Stream. Atmospheric water vapor attenuates the altimeter pulse and produces erroneous undulations in the resultant sea surface topography. This report identifies the magnitude and spatial scales associated with water vapor attenuation so that the GOAP analyst can better anticipate the problem at hand. SEASAT scanning multichannel microwave radiometer data is used to define water vapor gradients over the Gulf Stream. The 1978 data clearly reveals that attenuation due to water vapor alone can be 20 to 40% as large as the 50 to 100 cm signal characteristic of ocean fronts and eddies. These water vapor gradients also occur on the same scale (100 to 250 km) as the mesoscale ocean features, illustrating the point that the GOAP analyst must interpret individual track information with caution to avoid errors in analysis. A study was also done to simulate what effect these water vapor errors would have on objectively contoured topographic fields while attenuation due to water vapor has some impact, it is outweighed by the problems associated with low data density and consequent distortion introduced by the interpolation scheme. GRA

N87-21538# Naval Research Lab., Washington, D. C.
CHARACTERISTICS OF THE TWO-DIMENSIONAL SPECTRUM OF ROUGHNESS ON A SEAMOUNT Interim Report, Oct. 1984 - Oct. 1985
Michael F. Czarnecki and John M. Bergin 23 Dec. 1986 25 p
(AD-A176366; NRL-9022) Avail: NTIS HC A02/MF A01 CSCL 08/10

Advances in bottom mapping technology, such as multibeam bathymetric survey systems, have made it possible to obtain detailed depth measurements over two horizontal dimensions and to develop statistical models that describe variability of small-scale ocean bottom roughness. This report investigates the nature of the two dimensional power spectrum of the bottom roughness of a seamount. The characteristics of the power spectra are discussed; particular emphasis is placed on the issues of anisotropy and the power law behavior of the bottom roughness. GRA

N87-21539# Naval Postgraduate School, Monterey, Calif.
ANALYSIS OF WATER COLUMN STABILITY USING SHIPBOARD AND SUBMARINE DENSITY AND SHEAR MEASUREMENTS M.S. Thesis
Edward G. Beale, Jr. Dec. 1986 88 p
(AD-A176589) Avail: NTIS HC A05/MF A01 CSCL 08/10

Analysis of water column stability was performed using shipboard and submarine shear and density profile data acquired by U.S.S. DOLPHIN and R/V ACANIA in October, 1984 in the vicinity of Monterey Bay, California. Data was acquired utilizing CTD and acoustic doppler profiler (ADVP) instruments. The upper ocean thermohaline structure and water column stability, over a 10km square domain, was determined from repeated measurements of the conductivity, temperature, and velocity to a depth of 115m. The temporal and spatial variation in the analyzed fields of temperature, salinity, density, and velocity are compared with the constructed profiles of the static stability parameter (E) and gradient Richardson number. The analyzed fields were in turn compared with the larger scale forcing factors of coastal upwelling, current systems, bottom topography, and internal waves. The stability of the water column was found to be both statically and dynamically stable with the exception of thin patches of instability which were determined to be the result of double diffusive processes. GRA

N87-21540# Naval Postgraduate School, Monterey, Calif.
A NUMERICAL METHOD FOR SOLVING FOR NORMAL MODES WITH IMPEDANCE BOTTOM M.S. Thesis
Douglas Cantley Dec. 1986 99 p
(AD-A176591) Avail: NTIS HC A05/MF A01 CSCL 08/10

The development of a computer program is described which calculates the propagation loss for low frequencies in a shallow ocean given the depth of source and receiver, the sound speed profile of the water, the frequency of the source, and the impedance and sound speed at the bottom. The program does this by computing the sum of normal modes for a specified set of boundary condition at the bottom and is one of impedance mismatch. An effort was made to develop a Fast Field Program, which would use a FFT to predict propagation loss at a variety of ranges by solving for a discrete set of wave numbers, but development was not completed. GRA

N87-21541# Naval Postgraduate School, Monterey, Calif.
HYDROGRAPHIC DATA FROM THE OPTOMA (OCEAN PREDICTION THROUGH OBSERVATION, MODELING AND ANALYSIS) PROGRAM OPTOMA21, 7-20 JULY 1986 Progress Report, May - Jul. 1986
Paul A. Wittmann, Melissa L. Ciandro, Arlene A. Bird, and Christopher N. Mooers 12 Jan. 1987 65 p
(AD-A176638) Avail: NTIS HC A04/MF A01 CSCL 08/3

The OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program, a joint NPS/Harvard program sponsored by ONR, seeks to understand the mesoscale (fronts, eddies, and jets) variability and dynamics of the California current systems and to determine the scientific limits to practical mesoscale ocean forecasting. To help carry out the aims of this project a series of cruises has been planned for two subdomains, nocal and cencal. Optoma21 was a multidisciplinary study which took place from 7 to 20 July 1986 aboard the R/V Point Sur in the nocal domain. In addition to conducting a quasi-synoptic CTD/XBT mapping of a cool anomaly, meandering jet, and eddy system, measurements were made to determine: (1) the fine scale variability of the upper ocean mass and velocity fields; (2) the upper ocean nutrient, optical and phytoplankton fields; and (3) the structure of the zooplankton population. In this report, the CTD/XBT data are presented. GRA

N87-21542# Naval Postgraduate School, Monterey, Calif.
HYDROGRAPHIC DATA FROM THE OPTOMA (OCEAN PREDICTION THROUGH OBSERVATION, MODELING AND ANALYSIS) PROGRAM OPTOMA22, 27 JULY-5 AUGUST 1986 Progress Report, Jul. - Aug. 1986
Melissa L. Ciandro, Paul A. Whittmann, Arlene A. Bird, and Christopher N. Mooers 28 Dec. 1986 48 p
(AD-A176639; NPS-68-86-012) Avail: NTIS HC A03/MF A01 CSCL 08/3

The OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) Program, a joint NPS/Harvard program sponsored by ONR, seeks to understand the mesoscale (fronts, eddies, and jets) variability and dynamics of the California Current System and to determine the scientific limits to practical mesoscale ocean forecasting. To help carry out the aims of this project, a series of cruises has been planned in two subdomains, NOCAL and CENCAL. The cruise, OPTOMA22, was undertaken during the period 27 July to 5 August 1986, on the USNS De Steiguer, and sampled a domain approximately 240km square centered about 280km off the coast between Pt. Arena and Cape Mendocino. Oceanographic stations were occupied during the period 27 July to 5 August at approximately 18km along each track. GRA

N87-21543# Rhode Island Univ., Kingston. Graduate School of Oceanography.
THE GULF STREAM DYNAMICS EXPERIMENT: INVERTED ECHO SOUNDER DATA REPORT FOR THE JULY 1982 TO APRIL 1983 DEPLOYMENT PERIOD Summary Report
Amy I. Friedlander, Karen L. Tracey, and D. R. Watts Oct. 1986 107 p
(Grant NSF OCE-82-01222)
(AD-A176776; URI/GSO-TR-86-5) Avail: NTIS HC A06/MF A01 CSCL 08/3

The Gulf Stream Dynamics Experiment was conducted in the region just northeast of Cape Hatteras to study the propagation and growth characteristics of Gulf Stream meanders. This report documents the inverted echo sounder data collected during the July 1982 to April 1983 deployment period. Time series plots of the half-hourly travel time and low-pass filtered thermocline depth measurements are presented for eleven instruments. Basic

statistics are given for all the data records shown. Maps of the thermocline depth field in a 200 km by 400 km region are presented at daily intervals. GRA

N87-21544# Naval Postgraduate School, Monterey, Calif.
HYDROGRAPHIC DATA FROM THE OPTOMA (OCEAN PREDICTION THROUGH OBSERVATION, MODELING AND ANALYSIS) PROGRAM OPTOMA20, 16 MARCH -6 MAY 1986 Progress Report, Mar. - May 1986
Melissa L. Ciandro, Paul A. Wittman, Arlene A. Bird, and Christopher N. Mooers 10 Nov. 1986 187 p
(AD-A176795; NPS-68-86-008) Avail: NTIS HC A09/MF A01 CSCL 08/3

THe OPTOMA (Ocean Prediction Through Observation, Modeling, and Analysis) program seeks to understand the mesoscale (fronts, eddies, and jets) variability and dynamics of the California Current System and to determine the scientific limits to practical mesoscale ocean forecasting. To help carry out the aims of this project, a series of cruises has been planned in two subdomains, NOCAL and CENCAL. Three cruises were undertaken during March, April and May 1986: two (Legs MI and MII) on the NOAA ship Mc AUTHOR, one (Leg D) on the USNS DE STEIGUER. In addition, one P-3 overflight (Leg P) was made one week before the first cruise. Leg P, on 16 March, sampled a domain approximately 240km square centered about 280 km off the coast between Pt. Arena and Cape Mendocino, with additional transects from and to San Francisco, Leg MI was carried out from 24 March to 3 April (Figure 8), Leg MII from 7 to 15 April (Figure 20), and Leg D from 25 April to 6 May (Figure 32). Each cruise sampled the same domain as Leg P. On these cruises, oceanographic stations were occupied at approximately 18km along each track. GRA

N87-21545# Naval Postgraduate School, Monterey, Calif.
WIND FORCING EXPERIMENTS IN THE CALIFORNIA CURRENT SYSTEM M.S. Thesis
Philip G. Renaud Dec. 1986 88 p
(AD-A176818) Avail: NTIS HC A05/MF A01 CSCL 08/3

A high-resolution, multi-level, primitive equation ocean model is used to examine the response of an idealized, flat-bottom, oceanic regime off northern California to steady, equatorward, local wind-forcing during the upwelling season. The model has open boundaries on all but the eastern coastal boundary on which either free-slip or zero-slip boundary conditions are imposed. Time-invariant winds, either with or without a component of wind stress curl, are used as model forcing to spin-up a classical two-dimensional, upwelling-induced coastal jet and undercurrent. Since no eddies are generated, a stability analysis of the mean flow is conducted which explores both the necessary conditions of mixed (barotropic and baroclinic) instability, through calculations of potential vorticity, and the sufficient conditions for baroclinic instability, through an application of a simple two-layer stability model. Comparisons of model results with observations of the coastal jet in the California Current System indicate that the location and the horizontal and vertical current shear associated with the model coastal jet compare favorably with observations; however the modeled jet is stronger, deeper and wider than the observed jet. GRA

N87-21546# Naval Postgraduate School, Monterey, Calif.
REMOTE SENSING OF OCEAN SEDIMENT VOLUME REVERBERATION M.S. Thesis
Chin-Wen Chang Dec. 1986 119 p
(AD-A177188) Avail: NTIS HC A06/MF A01 CSCL 20/4

An experimental study was performed to establish a technique for measuring the volume reverberation from ocean sediments Two types of sediments (aggregate and fine sand) were used in this study. The inhomogeneity within the sediment caused considerable sample to sample fluctuation in the scattered waveform. This fluctuation was removed by spatial averaging to obtain a mean value over the sampling area. An approximate model for volume reverberation from sediments was developed for an acoustic pulse with an exponential decay. The results are promising. Combining the model and experimental results, the volume scattering coefficient obtained for the aggregate is 0.0624 + or - 0.007 m and for fine sand is 0.0413 + or - 0.007 m. The latter result is close to the coefficient obtained from a cloud-of-small spheres model for wavelengths and much greater than the particle size. GRA

N87-21547# Skidaway Inst. of Oceanography, Savannah, Ga.
BIOLOGICAL PROCESSES IN THE WATER COLUMN OF THE SOUTH ATLANTIC BIGHT: PHYTOPLANKTON RESPONSES Progress Report, Jun. 1986 - May 1987
J. A. Yoder 3 Dec. 1986 48 p
(Contract DE-FG09-85ER-60353)
(DE87-003987; DOE/ER-60353/2) Avail: NTIS HC A03/MF A01

Research progress is reported in the following areas: (1) BIOTRANS - phytoplankton studies; (2) microzooplankton studies; and (3) analysis of CZCS imagery. DOE

N87-21548# Brookhaven National Lab., Upton, N. Y.
IS THE SOMALI CURRENT A BIOLOGICAL RIVER IN THE NORTHWESTERN INDIAN OCEAN
S. L. Smith 1986 15 p Presented at the Symposium on Marine Biology of the Arabian Sea, Karachi, Pakistan, 29 Mar. 1986
(Contract DE-AC02-76CH-00016)
(DE87-003233; BNL-38942; CONF-8603173-1) Avail: NTIS HC A02/MF A01

Calculations of diversity, equitability, average rank, and average percentage of total numbers show that the addition of zooplanktonic taxa such as Calanus carinatus arising in the upwelling areas during the southwest monsoon does significantly increase diversity and equitability of the community. Rank and percentages of total numbers, however, show that the response is not entirely due to the presence of Calanoides carinatus during the southwest monsoon. Another important change in the zooplanktonic community was the decline in the abundance of Oithona spp. in upwelling areas during the southwest monsoon. DOE

N87-21549# National Ocean Service, Rockville, Md. Office of Oceanography and Marine Assessment.
CHESAPEAKE BAY CIRCULATION SURVEY: 1981-1983
D. R. Browne and C. W. Fisher Aug. 1986 80 p
(PB87-138194; SR-8) Avail: NTIS HC A05/MF A01 CSCL 08J

One of the major goals of the National Ocean Service (NOS), a major element of the National Oceanic and Atmospheric Administration (NOAA), is to define the tidal circulation in the Nation's estuaries and waterways for navigation purposes. In an investigation of the historical data files at NOS, it was found that the latest circulation survey conducted in the Chesapeake Bay in 1964 was for only a small area in the Bay. During August 1981, NOS began a 2 1/2 year circulation survey of the Chesapeake Bay from its entrance to the Susquehanna River, through the Chesapeake and Delaware Canal and into the Delaware River. GRA

N87-21550# Massachusetts Inst. of Tech., Cambridge. Sea Grant Coll. Program.
DIRECTORY OF MIT (MASSACHUSETTS INSTITUTE OF TECHNOLOGY) SEA GRANT COLLEGE PROGRAM PUBLICATIONS, 1978-1986
Sep. 1986 127 p
(PB87-137105; MITSG-86/11) Avail: NTIS HC A07/MF A01 CSCL 08J

Since MIT became part of the National Sea Grant network of universities in 1968, the program has issued over 300 technical, advisory, and educational publications. These publications represent the range of Sea Grant-Sponsored research and the Program's dedication to making useful information available to any student, citizen, company, or government concerned with the use of the nation's marine resources. The volume complements MITSG 78-6, a directory listing all MIT Sea Grant Program publications from 1970-1977, and includes cumulative indices to both volumes. GRA

N87-21551# Woods Hole Oceanographic Institution, Mass.
TECHNICAL DESCRIPTION OF AN ACOUSTIC DOPPLER BASED UPPER OCEAN PROFILING SYSTEM
A. C. Zani and N. R. Galbraith Apr. 1986 73 p
(Grants NSF OCE-84-16197; NSF OCE-84-00128)
(PB87-142162; WHOI-86-13) Avail: NTIS HC A04/MF A01 CSCL 08C

An acoustic Doppler profiler has been designed into a multi-sensor Acoustic Profiler of Ocean Currents system (APOC). All four major components of the data collecting ensemble are microprocessor based units, allowing programmatic flexibility. Various water column, meteorological, and navigation data are recorded in a raw and/or processed form. The equipment has collected data during five cruises, for a total of approximately 190 days at sea. A hardware and software description of the system is presented. GRA

N87-21497# Istituto di Fisica dell Atmosfera, Rome (Italy).
REMOTELY SENSED SEA SURFACE TEMPERATURE FOR THE ALPINE EXPERIMENT (ALPEX)
G. Dalu, A. Viola, and S. Marullo *In* WMO Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1 Jul. 1986 p 131-138 Sponsored by CNR
(For primary document see N87-21485 14-47)
Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

51 LIFE SCIENCES (GENERAL)

N87-21580# Joint Publications Research Service, Arlington, Va.
RAT BRAIN POLYAMINE LEVELS DURING LONG-TERM HYPOKINESIA
V. Yu. Kovalev and R. A. Tigranyan *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 130-132 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 86-87 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

N87-21581# Joint Publications Research Service, Arlington, Va.
REACTION OF SYMPATHECTOMIED RAT OPIOID SYSTEM TO IMMOBILIZATION STRESS
R. A. Tigranyan and O. P. Vakulina *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 133-136 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 87-90 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

N87-21582# Joint Publications Research Service, Arlington, Va.
RADIOSENSITIVITY OF ESCHERICHIA COLI FOLLOWING IRRADIATION IN A STATIONARY MAGNETIC FIELD
M. I. Minkova and T. P. Pantev *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 137-139 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 87-90 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N87-21552* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 297)
May 1987 45 p
(NASA-SP-7011(297); NAS 1.21:7011(297)) Avail: NTIS HC A03 CSCL 06E

This bibliography lists 89 reports, articles and other documents introduced into the NASA scientific and technical information system in April, 1987. Author

N87-21553# Research Inst. for Road Vehicles, TNO, Delft (Netherlands).
PRELIMINARY DEVELOPMENT, HEAD-NECK SIMULATOR. VOLUME 1: ANALYSIS VOLUNTEER TESTS Final Report
J. S. H. M. Wismans Aug. 1986 111 p Prepared in cooperation with National Highway Traffic Safety Administration, East Liberty, Ohio Sponsored by National Highway Traffic Safety Administration, East Liberty, Ohio
(PB87-133245; DOT-HS-807-034) Avail: NTIS HC A06/MF A01 CSCL 06P

The initial work of an ongoing research program of which the objective is to develop a head-neck simulator with omni-directional biofidelity is documented. In Volume 1 of a two volume set, a detailed analysis is presented of a large number of human volunteer tests conducted by the Naval Biodynamics Laboratory in New Orleans. The human subjects were exposed to frontal, lateral and oblique impacts with an impact severity up to 15 g and 17 m/s. The analysis results for each impact direction in a simple analog system that completely specifies the observed dynamical behavior are presented. Author

N87-21554*# Howard Univ., Washington, D. C. Dept. of Physiology and Biophysics.
NEUROHUMORAL AND MECHANICAL FACTORS IN THE MODULATION OF LEFT VENTRICULAR MASS Final Report, 23 Sep. 1983 - 31 Oct. 1986
Eleanor I. Franklin and Edward W. Hawthorne 12 May 1987 8 p
(Grant NAG2-250)
(NASA-CR-180524; NAS 1.26:180524) Avail: NTIS HC A02/MF A01 CSCL 06P

The goals for the research were to define, describe, and study those neuroendocrine and mechanical mechanisms that may play a role in the initiation and maintenance of an increase in, or cause regression of, the mass of the left ventricle. Dynamic changes in heart mass have been observed to occur in man and animals: (1) enlargement of the heart is frequently encountered in patients with hypertensive disease, and (2) decrease in heart mass has been reported for men exposed to prolonged space flight. The basic physiologic processes which may explain how these changes occur, and the effects of gain or loss of myocardial mass on cardiac performance were considered significant questions to be answered for the benefit of the National Aeronautics and Space Administration. Author

N87-21555# Indiana Univ., Indianapolis. Research and Sponsored Programs.
SLEEP DEPRIVATION AND EXERCISE TOLERANCE Annual Report, 1 Feb. 1985 - 31 Jan. 1986
Bruce J. Martin 31 Jan. 1986 10 p
(Contracts DAMD17-81-C-1023; DA Proj. 3E1-62777-A-879)
(AD-A176171) Avail: NTIS HC A02/MF A01 CSCL 06/19

Sleep loss appears to influence subsequent exercise in a manner dependent upon the nature of that exercise. To investigate this, the author examined the effect of 24 sleepless hours on the ability to produce and maintain maximal ventilation, a form of exercise involving a limited muscle mass. It was found that sleep loss reduced maximal ventilatory output and also resulted in persistent mood changes. In addition, sleep loss worsened performance of both short- and long-term maximal ventilation, indicating that its influence was not limited to prolonged, boring tasks. It was concluded that those forms of exercise utilizing the

largest muscle mass are most resistant to the influence of sleep deprivation. Author (GRA)

N87-21556# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE EFFECT OF ALTERED LEVELS OF CARBON DIOXIDE ON THE INCIDENCE OF ALTITUDE DECOMPRESSION SICKNESS Ph.D. Thesis
Ronald C. Hill 1987 140 p
(AD-A176558; AFIT/CI/NR-87-25D) Avail: NTIS HC A07/MF A01 CSCL 06/5

Goats were exposed to 30, 32, and 34 thousand ft simulated altitude while breathing carbon dioxide tensions of 15, 30, or 46 tor in oxygen during 15-min prebreathing and 30-min peak altitude exposures. Risk of decompression was determined by detecting venous gas emboli (VGE) in the pulmonary artery with an implanted Doppler cuff. VGE scores were calculated using the ratio of cardiac cycles containing VGE to total cardiac cycles. The VGE scoring methodology proved sensitive to other treatment effects (air versus oxygen prebreathing); however, no significant change in VGE scores occurred as a result of varying the carbon dioxide level in the inspired air. Furthermore, there was no significant change in cardiac index during the various carbon dioxide exposures and the VGE scores were not correlated with cardiac index. Ground level studies revealed that end-tidal carbon dioxide tensions were significantly elevated at all three levels of inspired carbon dioxide, but no change in cardiac index was observed. In a trial involving one animal, conditions producing high VGE scores did not produce arterial emboli. Short duration prebreathing of carbon dioxide in oxygen does not appear to affect DCS incidence. GRA

N87-21557# Research Inst. for Road Vehicles, TNO, Delft (Netherlands).
PRELIMINARY DEVELOPMENT HEAD-NECK SIMULATOR. VOLUME 2: MATHEMATICAL SIMULATIONS Final Report, Sep. 1982 - Oct. 1984
T. G. M. Hoen and J. S. H. M. Wismans Aug. 1986 216 p
Sponsored by National Highway Traffic Safety Administration
(PB87-142196; DOT-HS-807-035) Avail: NTIS HC A10/MF A01 CSCL 06K

The report documents the initial work of an ongoing research program of which the objective is to develop a head-neck simulator with omni-directional biofidelity. Volume 2 documents the validation of the proposed analog systems and compares the behavior of the Part 572 and Hybrid 3 head-neck systems with the human volunteer behavior. It follows that both neck designs are stiffer than any of the volunteers in the impact ranges tested. Preliminary results are presented of computer aided design activities in order to improve existing designs in view of these new findings. GRA

N87-21558# Joint Publications Research Service, Arlington, Va.
USSR REPORT: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 20, NO. 6, NOVEMBER - DECEMBER 1986
O. G. Gazenko, ed. 19 Mar. 1987 152 p Transl. into ENGLISH of Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), Vol. 20, No. 6, Nov. - Dec. 1986 96 p
(JPRS-USB-87-001) Avail: NTIS HC A01/MF A01

Translations from a Russian language bimonthly journal are presented. The articles are mainly on the effects of long duration space flight on physiology of human beings. The contents range from the medical screening of cosmonauts to the effect of a stationary magnetic field on escherichia coli. Other effects examined are long term immobilization, hypokinesia and group dynamics under extreme conditions. For individual titles, see N87-21559 through N87-21582.

N87-21559# Joint Publications Research Service, Arlington, Va.
INCEPTION OF SOVIET SYSTEM OF MEDICAL SCREENING OF COSMONAUTS (HOSPITAL STAGE)
M. D. Vyadro and I. I. Bryanov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 1-7 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 3-7 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

The system of medical selection of Soviet cosmonauts stemmed from that used in aviation medicine, particularly medical expertise of flying personnel. Selection in the hospital included two-stage detailed clinical and physiological examinations using various provocative tests. The system of medical selection and clarification of medical requirements was improved and refined through regular observations over candidates and cosmonauts and careful analysis of their grounding due to medical problems. The American and Soviet systems of selection used at an early stage of space programs are compared and similarities and differences between them are indicated. Author

N87-21560# Joint Publications Research Service, Arlington, Va.
EFFECT OF SPACEFLIGHT FACTORS ON HEMOPOIESIS
M. P. Kalandarova *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 8-23 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 7-17 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Published data concerning space flight effects upon hemopoiesis are discussed. Possible pathogenetic mechanisms of hemopoietic changes in response to space flight effects are described. Author

N87-21561# Joint Publications Research Service, Arlington, Va.
EVALUATION OF FUNCTIONAL STATE OF PILOTS ON THE BASIS OF INTERHEMISPHERIC ASYMMETRY
V. A. Bodrov and A. G. Fedoruk *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 24-28 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 18-21 (For primary document see N87-21558 14-52)
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The stability of the functional asymmetry of brain hemispheres (with respect to the right ear coefficient-REC) of pilots was investigated during their exposure to extreme flight factors. It was found that the functional asymmetry of brain hemispheres was sufficiently stable in the subjects whose initial REC was not less than 10%. After exposure the decline of the REC in some subjects was accompanied by deterioration of their health status and quality of their operational work. Author

N87-21562# Joint Publications Research Service, Arlington, Va.
INDIVIDUAL DISTINCTIONS OF FLUID-ELECTROLYTE METABOLISM DURING HYPOKINESIA WITH HEAD-DOWN TILT FOR 120 DAYS AND EFFICACY OF PREVENTIVE AGENTS
T. M. Smirnova, G. I. Kozyrevskaya, V. I. Lobachik, V. V. Zhidkov, and S. V. Abrosimov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 29-33 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 21-24 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Sodium balance and circulating plasma, intracellular, extracellular and interstitial fluid volumes were measured in the test subjects exposed for 120 days to head-down tilt at -5 deg. The large scatter of the above parameters was associated with individual variations and with the use of different countermeasures against demineralization (exercise and drugs-xydiphone and glucamak). The effect of the counter-measures was different in both qualitative and quantitative terms. It appears that the target of their action was different. The best prophylactic effect was seen when exercise and drugs were used in combination. These findings suggest that individual variations of fluid-electrolyte metabolism during prolonged hypokinesia are related to the different capacity of tissues for water and electrolytes. Author

N87-21563# Joint Publications Research Service, Arlington, Va.
BIOELECTRICAL ACTIVITY OF THE HEART AND BLOOD ELECTROLYTES IN ESSENTIALLY HEALTHY SUBJECTS SUBMITTED TO ANTIORTHOSTATIC HYPOKINESIA FOR 120 DAYS
N. P. Artamonova, T. S. Zakharova, B. V. Morukov, G. S. Arzamazov, and V. Yu. Semenov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 34-38 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 24-27 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Electrocardiographic parameters and serum concentrations of potassium, sodium, calcium (total and ionized) and magnesium in 6 essentially healthy men, aged 30 to 45 years, were measured before, during and after 120-day head-down tilt at -4.5 deg. A close correlation was demonstrated between T-wave depression and serum concentrations of potassium (direct correlation) and calcium and magnesium (inverse correlation). No consistent changes in the sodium content during the 120-day test were seen. In spite of electrolyte changes in blood induced by head-down tilt, ECG variations showed minor hypokaliemia that was not followed by any clinical symptoms. These data can be used to evaluate the status of healthy people exposed to prolonged hypokinesia and to develop adequate prophylactic measures.
Author

N87-21564# Joint Publications Research Service, Arlington, Va.
EFFECT OF IMMERSION HYPOKINESIA ON SOME PARAMETERS OF HUMAN MUSCLE POTENTIALS
L. G. Khristova, A. A. Gidikov, I. F. Aslanova, A. V. Kirenskaya, V. G. Kozlova, and I. B. Kozlovskaya *In its* USSR Report: Space Biology and Aerospace Medicine Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 39-43 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 27-31 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

During 3-day immersion hypokinesia stimulation, muscle potentials and averaged potentials of total EMG of m. biceps brachii were investigated in six test subjects. Stimulation potentials were obtained by exciting n. cutaneus with a train of square impulses. Potentials were recorded using a combined multi-electrode. Averaged potentials of total EMG were recorded by means of the same electrode. The propagation rate of the potentials, duration of their negative and end-positive phases as well as the length of their negative phase in space were measured. In addition, vector-electromyographic images of the potentials were recorded. After immersion hypokinesia the propagation rate decreased significantly, the duration of the end-positive phase increased and the length of the depolarized zone of potentials in space shortened. The decrease of the rate of propagation of stimulation potentials was 28% and that of averaged potentials of total EMG was 31% per group. These changes developed rapidly enough, indicating shifts in the properties of potentials of action of myofibers during immersion. Factors responsible for these changes are discussed.
Author

N87-21565# Joint Publications Research Service, Arlington, Va.
CHANGE IN BILE ACID AND LIPID CONTENT OF HUMAN BILE DURING EXPOSURE TO ANTIORTHOSTATIC HYPOKINESIA AND ITS CORRECTION
I. L. Medkova, O. V. Zhiznevskaya, K. V. Smirnov, V. I. Lebedev, and Ye. M. Artamasova *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, no. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 44-51 Transl. into ENGLISH from Kosmichsekaya Biologya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 31-37 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

The spectrum of bile acids and bile lipids in men exposed to 120-day head-down tilt was investigated. The test subjects were subdivided into four groups: group 1-bed rest per se, group 2-bed rest + exercise, group 3-bed rest + drugs normalizing calcium metabolisms, and group 4-bed rest + exercise + drugs. It was anticipated that biliary concrements would primarily be formed in group 1 and 2 subjects. They showed a low level of bile acids and a high content of total Ca and cholesterol in the bile, which was more pronounced in the C portion. Group 2 subjects displayed a modified synthetic function of the liver: prevalence of tauroconjugates in the bile. Group 3 and 4 subjects showed a faster synthesis of bile acids in the liver and a lower content of total calcium and cholesterol in the bile, the latter being more distinct in group 4 subjects. Positive dynamics of these parameters is a factor responsible for a reduced lithogeny of the bile. However, the test subjects of these groups exhibited hazardous changes that may be responsible for concrement formation.
Author

N87-21566# Joint Publications Research Service, Arlington, Va.
QUANTITATIVE STUDY OF OSTEOBLASTS AND OSTEOCLASTS OF RAT BONES WITH SIMULATION OF WEIGHTLESSNESS
G. N. Durnova, Z. F. Sakharova, A. S. Kaplanskiy, V. M. Ivanov, and M. S. Khaydakov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 52-57 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 37-41 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Tibia and vertebrae of rats exposed to hypokinesia or head-down suspension were investigated by quantitative histomorphometry. It was found that 35- and 60-day hypokinesia as well as 35-day suspension caused osteoporosis in the tibial and vertebral spongiosa. The development of osteoporosis was accompanied by a significant reduction in the number of osteoblasts in the primary spongiosa of tibia and vertebrae whereas no noticeable changes in osteoclasts were observed either in hypokinetic or suspended rats. The only exception was lumbar vertebrae in which the amount of osteoclasts decreased as a result of 60-day hypokinesia. It is assumed that the reduction in the number and activity of osteoblasts plays the major part in the development of osteoporosis during hypokinesia and suspension.
Author

N87-21567# Joint Publications Research Service, Arlington, Va.
HYDROLYSIS, TRANSPORT AND UTILIZATION OF CARBOHYDRATES IN RATS WITH RESTRICTED MOTOR ACTIVITY
L. G. Goland-Ruvinova, R. A. Pechenkina, N. P. Goncharova, and K. V. Smirnov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 58-65 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 41-47 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Carbohydrate hydrolysis, transport and utilization were investigated in rats exposed to diminished motor activity for 90 days. Glycemic curves were examined using provocative tests with equivalent quantities of poly-, oligo- and monosaccharides. Simultaneously, carbohydrases were measured in the homogenates of the pancreas, duodenal mucosa and small intestine as well as radioimmune insulin and glucagon were determined in blood. In the course of hypokinesia carbohydrate hydrolysis, transport and utilization varied in a different manner. At the beginning of exposure the activity of carbohydrases responsible for carbohydrate hydrolysis in the cavity and membranes increased which was accompanied by hyperglycemia and rapid utilization of carbohydrates. This is associated with nonspecific reactions to hypokinesia and higher requirements of the body for the energy substrate. By hypokinesia day 30 carbohydrate hydrolysis and transport were inhibited, hypoglycemia developed but glucose utilization remained unchanged.
Author

N87-21568# Joint Publications Research Service, Arlington, Va.
POSSIBILITY OF PHARMACOLOGICAL CORRECTION OF

REGIONAL OSTEOPOROSIS IN NONBEARING EXTREMITY

I. V. Rogacheva, A. N. Polyakov, A. I. Volozhin, and G. P. Stupakov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 66-71 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 47-51 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

In 20- and 40-day rat studies the prophylactic effect of retabolil and calcitrin (calcitonin) against hypodynamics-induced osteoporosis was investigated. Hypodynamics was produced by surgical amputation of the lower third of the leg and hence by loss of the support function of the limb. Retabolil was injected intramuscularly at a dose of 0.2 ml once a day for 10 days and calcitrin was injected subcutaneously at a dose of 2 units MRC in 0.5 ml distilled water once a day. The results indicate that osteoporosis in the supportless bone of the experimental animals and that seen during space flight developed in a similar way. In the experiment retabolil and calcitrin inhibited the progressive development of osteoporosis but the strongest effect was obtained upon a combined application of the two drugs. Author

N87-21569# Joint Publications Research Service, Arlington, Va.
MORPHOLOGICAL AND BIOCHEMICAL ANALYSIS OF SOME RAT ORGANS AND TISSUES FOLLOWING EXPOSURE TO 1.1 AND 2.0 G GRAVITY

I. B. Krasnov, I. I. Babichenko, B. V. Afonin, and A. S. Pankova *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 72-81 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 51-58 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

During 30 days rats were centrifuged at 1.1 and 2.0 G. On centrifugation days 30 the rats showed body mass losses, decrease of plasma ACTH, activation of the renin-angiotensin-aldosterone system (RAAS) and ultrastructural changes in the mossy fiber terminals in the nodulus cortex which were indicative of the state of excitation or excess excitation in the system of the utriculus receptor cell and vestibular ganglion neuron (RCN). On the 2d day after centrifugation the ultrastructural changes in the terminals pointed to a lower activity of the RCN system which was below the physiological norm. As compared to centrifugation day 30, the RAAS became more active on the 2d day of recovery. On the 7th day of recovery the RCN ultrastructure, RAAS and ACTH concentrations returned to the normal. The general trends of the RAAS and RCN changes seen on the 2d day of recovery and identified by other authors at an acute stage of adaptation to microgravity suggest that the data obtained on the 2d day of recovery may be used to analyze certain effects which develop during an acute stage of adaptation to microgravity in mammalian organs and systems responsible for the perception of modified gravity and their adaptation to a new level of gravity. Author

N87-21570# Joint Publications Research Service, Arlington, Va.
EFFECT OF ALTERED CIRCULATION ON HUMAN NYSTAGMIC REACTIONS

V. V. Zaritskiy and Yu. V. Krylov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 82-86 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 58-62 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Optokinetic and vestibulooptokinetic nystagmus in response to optokinetic and combined vestibulo-optokinetic stimulation applied during head-down tilt was investigated. Tilt-induced circulation changes produced a modifying effect on nystagmic reactions which included a decrease of optokinetic and vestibulo-optokinetic nystagmus and its subsequent recovery after return to the horizontal position. The absolute parameters of vestibulo-optokinetic nystagmus changed depending on the direction of head movements in the sagittal plane relative to the long axis of the body. Some aspects of the relationships between sensory and nystagmic components of vestibular reactions during conflict stimulation of the vestibular and visual sensory systems are discussed. Author

N87-21571# Joint Publications Research Service, Arlington, Va.
THRESHOLDS OF LONG-LATENCY-PERIOD POTENTIALS AND SENSATION OF MOTION EVOKED IN MAN BY LINEAR ACCELERATIONS

K. F. Trinus *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 87-93 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 62-66 (For primary document see N87-21558 14-52)
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Forty-seven healthy test subjects were exposed several times each to linear acceleration of varying value. Depending on the acceleration value, they reported subjectively three types of sensations at the threshold level: nondiscriminated in terms of direction (P1), inverted (P2), and discriminated (P3). The acceleration value at which P2 was recorded caused most typical responses in different test subjects whereas that at which P3 was recorded induced greatest individual variations. Evoked potentials in response to linear acceleration were recorded in such a manner which excluded potential instrumental artefacts or possible contribution of eye movements, excitation of the hearing organ and muscle tone changes. The data obtained indicate that acceleration-induced evoked potentials are predominantly of vestibular origin and consist of three peaks, latencies of which are equal to 31.3 + or - 7.2, 69.1 + or - 9.1 and 157.6 + or - 10.5 msec at the threshold where they emerge. Author

N87-21572# Joint Publications Research Service, Arlington, Va.
MATHEMATICAL MODEL OF THE OTOLITH

A. V. Kondrachuk, I. Ye. Shchechkin, and S. P. Sirenko *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 94-99 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 66-70 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

A mathematical model of the otolith of mammals represented as a system with parameters of distribution is described. Two versions of the model are analyzed and the lowest frequencies of natural oscillations of the system are evaluated. Author

N87-21573# Joint Publications Research Service, Arlington, Va.
REACTIVITY OF ADRENOSYMPATHETIC SYSTEM AND TOLERANCE TO EXERCISE LOAD DURING REPEATED EXPOSURE TO STATIONARY MAGNETIC FIELD

L. D. Klimovskaya and L. V. Kokoreva *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 100-104 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 70-73 (For primary document see N87-21558 14-52)
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For 30 days, rats were exposed daily, 3 h a day, to a constant magnetic field of 1.6 T. The time within which the rats were swimming with a load until they were fatigued was measured and the concentration of catecholamines in blood and adrenals was determined. Two stages of the response to the magnetic field were identified. During the first stage (1-15 days) physical work capacity increased and the reactivity and reserve ability of the sympatho-adrenal system (SAS) grew. During the second stage (30th day and early recovery period) work capacity returned to normal and the SAS reactivity decreased, although the catecholamines stored in the adrenals remained unchanged. These findings indicate that SAS is involved in mechanisms underlying changes in work capacity and adaptation processes during exposure to a constant magnetic field. Author

N87-21574# Joint Publications Research Service, Arlington, Va.
DIRECT AND INDIRECT EFFECTS OF STATIONARY MAGNETIC FIELD ON BIOLOGICAL SYSTEMS
T. P. Pantev and M. I. Minkova *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 105-110 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 73-76 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

The effect of a constant magnetic field (CMF) of H = 2.3 x 100,000 A/m (2900 Oe) on the viability and radiosensitivity of E. coli B and the effect of magnetically activated water (MAW) on the radioresistance of rats were examined. The exposure did not influence the growth kinetics of E. coli B. Cell cultivation in the magnetically pretreated nutrient medium enhanced the bacterial growth. Preliminary exposure of bacterial cells to a CMF for 24 and 48 h increased and that for 72 h decreased their radioresistance. Twice a day the experimental weanlings were given MAW and the controls-tap water. The postradiation longevity of the MAW rats proved extended as compared to that of the controls. The MAW rats showed a higher osmotic stability of erythrocytes, a higher concentration of nucleic acids, and a larger count of leukocytes. Author

N87-21575# Joint Publications Research Service, Arlington, Va.
DERIVATION OF WORKING EQUATIONS OF CO2-CO-H2O-H2-N2 GAS MIXTURE FOR CATHODE SPACE OF ELECTROLYZER WITH SOLID ELECTROLYTE WITH CONSIDERATION OF EXTRACTED OXYGEN **c54**
B. G. Grishayenkov, V. K. Vasilyev, N. G. Zorina, and A. K. Zhukov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 111-116 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 76-79 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Equations of thermodynamic equilibrium of the gas mixture CO2-CO-H2O-H2-N2 for the cathode space of the electrolyzer containing a solid electrolyte with extracted oxgyen taken into consideration were derived. Equilibrium partial gas pressures, thermal effect of reactions, theoretical voltage of dissociation (the system of equations included 11 unknown parameters) were determined. These parameters are functions of temperature, total pressure of the gas mixture, initial gas composition, and the coefficient characterizing the degree of oxygen transfer from the cathode cell to the anode cell of the electrolyzer. Author

N87-21576# Joint Publications Research Service, Arlington, Va.
CALCULATION OF EQUILIBRATED CONCENTRATIONS OF CONSTITUENTS OF CO2-CO-H2O-H2-N2 GAS MIXTURE FOR CATHODE SPACE OF ELECTROLYZER WITH SOLID ELECTROLYTE AND CORRESPONDING VALUES OF THEORETICAL VOLTAGE OF DISSOCIATION **c54**
B. G. Grishayenkov, N. G. Zorina, and V. K. Vasilyev *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 117-120 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 79-81 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Calculation of thermodynamic equilibrium of a CO2-CO-H2O-H2-N2 gas mixture in the cathode space of an electrolyzer with solid electrolyte shows that theoretical voltage of dissociation of gas mixture E sub t as a function of oxygen content of the mixture (O/C+H) - (upsilon sub n) is represented by S-shaped curves for all tested temperatures. Elevation of electrolyzer temperature shifts the curves in the direction of decline of theoretical dissociation voltage, without changing their appearance. An increase in (H/C) sup 00 causes insignificant shift (0.018 V) of theoretical dissociation voltage at all tested temperatures. Author

N87-21577# Joint Publications Research Service, Arlington, Va.
SOME PATHOLOGICAL SIGNS IN PELVIS MINOR ORGANS AFTER EXPOSURE TO LONG-TERM HIGH-LEVEL +Gz ACCELERATIONS
A. S. Barer, A. A. Okhobotov, Ye. I. Sorokina, and V. M. Tardov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 121-122 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 81-82 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Circulatory conditions in the region of the human pelvis minor can be described as follows when performing maneuvers on modern aircraft involving long term accelerations of high levels. In the presence of an increasing hydrostatic component of blood pressure reaching about 27 to 32 kPa with 9 G accelerations, the antigravity gear effects compensatory mechanical compression of the anterior abdominal wall and lower extremities, forcing up to 700 cc blood from leg vessels to areas above them, which should ultimately lead to marked increase in blood volume. The first specific investigation revealed that adverse symptoms related to increased delivery of blood to organs of the pelvis minor can develop in the vascular system and, consequently, in organs situated in the region of the pelvis minor. In view of the clinical significance of the demonstrated phenomena, it is desirable to continue investigation of this matter from the standpoint of both diagnosis and development of a set of preventive measures. Author

N87-21578# Joint Publications Research Service, Arlington, Va.
GROUP DYNAMICS AND PERFORMANCE EFFICIENCY UNDER EXTREME CONDITIONS **c53**
Jan Tereljak *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 123-125 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. Dec. 1986 p 82-83 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

When psychologists analyze the process of social and emotional group dynamics of a small group spending the winter in Antarctica, they pay attention to the dynamics of psychophysiological responses related to this process. The behavioral disturbances discovered by a number of authors, which are elicited by long term natural isolation, form the so-called wintering syndrome. The most frequent manifestations of this syndrome are depression, hostility, irritability, impaired sleep, loss of interest on one's job, diminished intellectual capacities and interests. These signs are related to the duration of the stay in an isolated group, monotony of the environment (monotony, boredom) and absence of customary emotional stimuli. Analogous distinctions were also noted in many laboratory studies simulating spaceflight conditions, as well as during long term spaceflights. Author

N87-21579# Joint Publications Research Service, Arlington, Va.
MECHANISM OF ACTION OF LOCAL NEGATIVE PRESSURE APPLIED TO HUMAN BODY ON DYNAMICS OF CENTRAL CIRCULATION
V. V. Rumyantsev and A. I. Dyachenko *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 126-129 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 84-86 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Researchers are very interested in the effects of local negative (sub-atmospheric) pressure on the human body because of its extensive use in both space medicine and clinical practice. Use of lower body negative pressure (LBNP) is well-known as a mean of preventing the adverse effect of weightlessness on man and as a functional test to evaluate resistance of the circulatory system to gravity factors after spaceflights. Other methods of local decompression have been studied less. The main factors that

determine the response of central circulation to local negative pressure (LNP) on healthy man are demonstrated. Author

N87-21580# Joint Publications Research Service, Arlington, Va.
RAT BRAIN POLYAMINE LEVELS DURING LONG-TERM HYPOKINESIA c51
V. Yu. Kovalev and R. A. Tigranyan *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 130-132 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 86-87 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Hypokinesia leads to changes in various aspects of metabolic processes. Polyamines, which include putrescine, spermidine and spermine, are considered to be indicators of intensity of protein biosynthesis, since they stimulate it on the level of DNA transcription. There are no data in the literature concerning involvement of polyamines in processes of adaptation to hypokinesia. The levels of polyamines in different parts of the rat brain as related to different durations of hypokinesia are investigated. Author

N87-21581# Joint Publications Research Service, Arlington, Va.
REACTION OF SYMPATHECTOMIED RAT OPIOID SYSTEM TO IMMOBILIZATION STRESS c51
R. A. Tigranyan and O. P. Vakulina *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 133-136 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 87-90 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

Catecholaminergic neurons of the brain form contacts with opioid neurons. There are data in the literature to the effect that there are opiate peptides in sympathetic nerve endings; however, little information is encountered about correlations between the catecholaminergic and opiate systems, and it is contradictory. It is assumed that opioids lower hyperactivity of noradrenergic neurons of the brain with exposure to stress. On the other hand, catecholamines of the brain participate in expression of some effects induced by opioide peptides, for example, in control of retention or stimulation of prolactin secretion. The reaction was studied of the opiate system to immobilization, with change in functional state of the catecholaminergic system of the brain and peripheral adrenergic innervation. Author

N87-21582# Joint Publications Research Service, Arlington, Va.
RADIOSENSITIVITY OF ESCHERICHIA COLI FOLLOWING IRRADIATION IN A STATIONARY MAGNETIC FIELD c51
M. I. Minkova and T. P. Pantev *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 137-139 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 87-90 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

There is change not only in general reactivity of an organism, but in different elements of the immune system under the effect of a stationary magnetic field (SMF). Saprophytic bacterial flora is present in the pressurized part of a craft. There is rather limited information about the effect of magnetic fields on microbial flora and its radiosensitivity. The effect of SMF was tested on growth and radiosensitivity of E. coli B. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N87-21583 Civil Aviation Authority, London (England).
OBJECTIVE TESTING FOR THE PILOT'S INSTRUMENT RATING. SPECIMEN EXAMINATION MATERIAL: FLIGHT PLANNING AND NAVIGATION PROCEDURES, FLIGHT INSTRUMENTS AND RADIO AIDS, METEOROLOGY, AVIATION LAW, FLIGHT RULES AND PROCEDURES
Aug. 1986 28 p
(CAP-519; ISBN-0-86039-283-X; ETN-87-99500) Copyright. Avail: Issuing Activity

Specimen examination papers for the United Kingdom pilot license are presented. ESA

N87-21578# Joint Publications Research Service, Arlington, Va.
GROUP DYNAMICS AND PERFORMANCE EFFICIENCY UNDER EXTREME CONDITIONS
Jan Tereljak *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 123-125 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. Dec. 1986 p 82-83 (For primary document see N87-21558 14-52)
Avail: NTIS HC A01/MF A01

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N87-21584*# Eloret Corp., Palo Alto, Calif.
IMPACT VERIFICATION OF SPACE SUIT DESIGN FOR SPACE STATION
Richard H. Fish 12 May 1987 16 p
(Contract NCC2-347)
(NASA-CR-180456; NAS 1.26:180456) Avail: NTIS HC A02/MF A01 CSCL 06Q

The ballistic limits of single sheet and double sheet structures made of 6061 T6 Aluminum of 1.8 mm and larger nominal thickness were investigated for projectiles of 1.5 mm diameter fired in the Vertical Gun Range Test Facility and NASA Ames Research Center. The hole diameters and sheet deformation behavior were studied for various ratios of sheet spacing to projectile diameter. The results indicate that for projectiles of less than 1.5 mm diameter the ballistic limit exceeds the nominal 10 km/sec orbital debris encounter velocity, if a single-sheet suit of 1.8 mm thickness is behind a single bumper sheet of 1 mm thickness spaced 12.5 mm apart. Author

N87-21585*# Southern California Inst. of Architecture, Santa Monica. Inst. for Future Studies.
SPACE STATION GROUP ACTIVITIES HABITABILITY MODULE STUDY Final Report
David Nixon Washington NASA 1986 109 p
(Contract NCC2-356)
(NASA-CR-4010; NAS 1.26:4010) Avail: NTIS HC A06/MF A01 CSCL 06K

This study explores and analyzes architectural design approaches for the interior of the Space Station Habitability Module (originally defined as Habitability Module 1 in Space Station Reference Configuration Decription, JSC-19989, August 1984). In the Research Phase, architectural program and habitability design guidelines are specified. In the Schematic Design Phase, a range of alternative concepts is described and illustrated with drawings, scale-model photographs and design analysis evaluations. Recommendations are presented on the internal architectural, configuration of the Space Station Habitability Module for such functions as the wardroom, galley, exercise facility, library and station control work station. The models show full design configurations for on-orbit performance. Author

N87-21586# Anacapa Sciences, Inc., Fort Rucker, Ala.
HUMAN FACTORS RESEARCH IN AIRCREW PERFORMANCE

AND TRAINING Annual Summary Report, Sep. 1983 - Aug. 1984
Kenneth D. Cross Nov. 1986 139 p
(Contract MDA903-81-C-0504; DA Proj. 2Q2-63731-A-792; DA Proj. 2Q2-63739-A-793)
(AD-A176099; ASI-479-061-84; ARI-RN-86-97) Avail: NTIS HC A07/MF A01 CSCL 05/9

This report presents a summary of the work performed by Anacapa Sciences, Inc. (ASI) for the Army Research Institute (ARI) Field Unit at Fort Rucker Alabama, under the contract Human Factors Research in Aircrew Performance and Training. This research note contains summary descriptions of each of the projects on which ASI personnel worked during the third contract year -- September 1983 to August 1984. Each summary description contains: a background section that described the rationale for the research and the research objectives; a research approach section that described the tasks and activities required to fulfill the project objectives; and a project status section that describes the work completed, the preliminary findings (if available), and the anticipated project completion date. GRA

N87-21587# Naval Air Development Center, Warminster, Pa.
CENTRIFUGE TESTING OF A G COMPENSATED/PRESSURE DEMAND OXYGEN REGULATOR Interim Report
Philip E. Whitley and Leonid Hrebien Apr. 1986 13 p
(AD-A176117; NADC-86139-60) Avail: NTIS HC A02/MF A01 CSCL 06/11

Six subjects were exposed to unassisted positive pressure breathing at levels not exceeding 30 mmHg breathing pressure while riding on a centrifuge. Acceleration in the +Gz direction was applied as either a ramp or a plateau and conditions ranged from relaxed to unassisted positive pressure breathing with an anti-G suit. The purpose of this study was to evaluate the performance of a G compensated positive pressure breathing regulator with respect to stated output pressure versus +Gz level, the pressure control concept/schedule employed, and subject acceleration tolerance. The regulator was found to perform as stated given the pressure range of interest and the experimental conditions. The pressure control concept/schedule and acceleration tolerance were related factors. It was found that the subjects who rode to higher =Gz levels received higher levels of breathing pressure and in turn an increase in acceleration tolerance. GRA

N87-21588# Analytics, Inc., Willow Grove, Pa.
THEORETICAL DEVELOPMENT FOR IDENTIFYING UNDERLYING INTERNAL PROCESSES. VOLUME 1. THE THEORY OF UNDERLYING INTERNAL PROCESSES Interim Report
R. J. Wherry, Jr. Aug. 1986 74 p
(Contract N62269-82-D-0131; Proj. WR0-4210)
(AD-A176466; NAMRL-SR-86-1; NADC-86105-60-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 05/5

The theory of Underlying Internal Processes (UIPs) is basically a framework for discussing possible causes of good and poor human task performance and discovering what internal processes may underline that behavior. The theory assumes speed and accuracy of task performance is a direct result of the speed and accuracy of the various internal processes being used during the performance of that particular task. The UIP theory requires no arbitrary distinction between various traditionally recognized process categories (e.g., sensory perceptual, cognitive, memory, or motor). Nor is the theory directly concerned with either the site of, or the mechanisms needed for, the internal processes. It may well be that the UIP theory will be useful in addressing these concerns, but the theory is primarily concerned with identifying the number and nature of the different internal processes involved in the performance of various tasks. GRA

N87-21589# Navy Personnel Research and Development Center, San Diego, Calif.
FY86 INDEPENDENT RESEARCH/INDEPENDENT EXPLORATORY DEVELOPMENT Annual Special Report, Oct. 1985 - Sep. 1986
Alice M. Crawford and Margen H. Metcalfe Jan. 1987 65 p
(AD-A176944; NPRDC-SR-87-1) Avail: NTIS HC A04/MF A01 CSCL 05/9

This report provides summaries of FY86 Independent Research (IR) and Independent Exploratory Development (IED) efforts and the IR/IED funding profile, and presentations and publications based on IR/IED efforts. The following IR efforts are described: models for calibrating multiple-choice items, enhancing approaches to multiple objective assignment, performance on computer-based cognitive task, knowledge and process in adult language competence, analysis of cognition in natural settings, and brain mechanisms for human color vision. The following IED efforts are described: development of graphic design aids, trend analysis for real-time stochastic problems, and changes in cognitive structures training. GRA

N87-21590# Atomic Energy of Canada Ltd., Pinawa (Manitoba). Nuclear Research Establishment.
EWAM: A MODEL FOR PREDICTING FOOD AND WATER INGESTION, AND INHALATION RATES OF MAN
R. Zach and J. W. Barnard Sep. 1985 59 p
(DE86-900117; AECL-8401) Avail: NTIS (US Sales Only) HC A04/MF A01

A computer model, EWAM (Energy, Water and Air Model), was designed and implemented for predicting food and water ingestion, and inhalation rates of man for use in environmental assessment models. EWAM uses physiological, energetic, nutritional and physical relationships in combination with activity time budgets, and mass and energy balances. The calculated ingestion and inhalation rates are closely related. Various age and sex classes of man are taken into account. EWAM is best described as a deterministic equilibrium or steady state model, operating on a daily time scale with both detailed research and more general assessment model features. The parameters of EWAM are reviewed and suitable values recommended to allow biologically meaningful predictions. DOE

N87-21575# Joint Publications Research Service, Arlington, Va.
DERIVATION OF WORKING EQUATIONS OF CO2-CO-H2O-H2-N2 GAS MIXTURE FOR CATHODE SPACE OF ELECTROLYZER WITH SOLID ELECTROLYTE WITH CONSIDERATION OF EXTRACTED OXYGEN
B. G. Grishayenkov, V. K. Vasilyev, N. G. Zorina, and A. K. Zhukov *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 111-116 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 76-79 (For primary document see N87-21558 14-52) Avail: NTIS HC A01/MF A01

N87-21576# Joint Publications Research Service, Arlington, Va.
CALCULATION OF EQUILIBRATED CONCENTRATIONS OF CONSTITUENTS OF CO2-CO-H2O-H2-N2 GAS MIXTURE FOR CATHODE SPACE OF ELECTROLYZER WITH SOLID ELECTROLYTE AND CORRESPONDING VALUES OF THEORETICAL VOLTAGE OF DISSOCIATION
B. G. Grishayenkov, N. G. Zorina, and V. K. Vasilyev *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 6, Nov. - Dec. 1986 (JPRS-USB-87-001) 19 Mar. 1987 p 117-120 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 6, Nov. - Dec. 1986 p 79-81 (For primary document see N87-21558 14-52) Avail: NTIS HC A01/MF A01

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N87-21591* National Aeronautics and Space Administration. Pasadena Office, Calif.
REED-SOLOMON DECODER Patent
Charles R. Lahmeyer, inventor (to NASA) Issued 10 Mar. 1987 20 p Filed 21 Nov. 1984 Supersedes N85-20680 (23 - 11, p 1699)
(NASA-Case-NPO-15982-1; US-Patent-4,649,541; US-Patent-Appl-SN-673685; US-Patent-Class-371-37; US-Patent-Class-371-40) Avail: US Patent and Trademark Office CSCL 09B

A Reed-Solomon decoder with dedicated hardware for five sequential algorithms was designed with overall pipelining by memory swapping between input, processing and output memories, and internal pipelining through the five algorithms. The code definition used in decoding is specified by a keyword received with each block of data so that a number of different code formats may be decoded by the same hardware.
Official Gazette of the U.S. Patent and Trademark Office

N87-21592# Royal Signals and Radar Establishment, Malvern (England).
A COMPILER-COMPILER FOR THE SCP3 MICRO-PROGRAM
N. D. Poultner Sep. 1986 70 p
(RSRE-MEMO-3982; BR101097; ETN-87-99798) Avail: NTIS HC A04/MF A01

The SCP3 compiler-compiler project used to generate microprogram assemblers and other small compilers from an attribute grammar description of the language is described. It runs on a Flex computer system. ESA

N87-21593# National Academy of Sciences - National Research Council, Washington, D. C. Energy Engineering Board.
AN AGENDA FOR IMPROVED EVALUATION OF SUPERCOMPUTER PERFORMANCE
1986 63 p
(Contract DE-FG05-85ER-25008)
(DE87-005698; DOE/ER-25008/T1) Avail: NTIS HC A04/MF A01

Supercomputers allow the solution of computational problems and the simulation of physical phenomena that may not be possible or economical by any other means. However, supercomputers are expensive to acquire and operate, and their design is undergoing rapid and fundamental change. Both of these circumstances demand reliable evaluation of supercomputer performance - on the one hand, to make the most of costly resources and, on the other, to devise and select even more powerful designs. DOE

N87-21594# Oak Ridge National Lab., Tenn.
HYPERCUBE APPLICATIONS AT OAK RIDGE NATIONAL LABORATORY
M. T. Heath 1986 23 p Presented at the 2d Conference on Hypercube Multiprocessors, Knoxville, Tenn., 29 Sep. 1986
(Contract DE-AC05-84OR-21400)
(DE87-005691; CONF-8609173-10) Avail: NTIS HC A02/MF A01

To determine the viability of hypercube architectures for solving a broad spectrum of computational problems typically arising at Oak Ridge National Laboratory, a representative set of applications was chosen for implementation on a hypercube. The projects included finite element fracture analysis, cascade simulation, geochemical contaminant transport, image analysis, molecular dynamics of polymers, density functional theory, and nonlinear magnetohydrodynamics. Each project was a collaborative effort of scientists and engineers from the discipline in which the problem arose and experienced hypercube users from a parallel computing research group. Results of each of these projects and an overall summary are included in this report. DOE

N87-21595# Rome Univ. (Italy). Dipt. di Fisica.
INTRODUCTION TO THE Z80 DIDACTIC ASSEMBLY [INTRODUZIONE ALLA SCHEDA DIDATTICA Z80]
Italo Vannucci 9 Oct. 1986 50 p In ITALIAN
(Nota-Interna-870; ETN-87-99763) Avail: NTIS HC A03/MF A01

A didactic circuit assembled to study the structure, characteristics, and utilization of Z80 microprocessor is presented. It was prepared in order to provide university physics students with a didactic approach to microprocessor utilization. The subjects include circuit and functional description, the full electric diagram, and examples of experiment control applications. ESA

N87-21596# National Academy of Sciences - National Research Council, Washington, D. C.
AGENDA FOR IMPROVED EVALUATION OF SUPERCOMPUTER PERFORMANCE Final Report
1986 66 p
(Contracts DE-FG05-85ER-25008; N00014-85-G-0233)
(PB87-137196) Avail: NTIS HC A04/MF A01 CSCL 09B

A substantial scientific community and body of literature are devoted to computer performance measurement and evaluation. Impressive successes have been achieved in theory, prediction, and experimentation for systems that have sequential architecture and applications that involve data handing and manipulation. Less successful and mature are the methods and measurements for evaluation of systems performance when scientific problems are run on supercomputers of diverse architectural characteristics. The complexity of these systems, together with the increasing diversity of computing architectures becoming available, makes evaluation of supercomputer performance more problematical, yet more important, than for the more common midrange computer systems. Moreover, what is learned about the performance of operational systems can be expected to guide the design of future systems.
GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

N87-21597 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
AUTOMATIC SHAPE PARAMETERISATION IN MACHINE VISION
V. F. Leavers (Kings Coll., London, England) and J. F. Boyce Nov. 1986 19 p
(Contract EMRM-82-0437)
(NPL-DITC-79/86; ISSN-0262-5369; ETN-87-99800) Copyright. Avail: Issuing Activity

A general method which uses the definition of a Radon transform as a means of defining a two dimensional transform space in which information about shape primitives may be simultaneously encoded is presented. Examples illustrate how the shape indicative distributions within the transform space may be deduced. The results show that each set of coded information is

transparent to any other, and that each shape indicative distribution may be located using a convolution mask peculiar to that distribution. ESA

N87-21598# Admiralty Research Establishment, Portland (England).
INTRODUCTION TO MASCOT 3
W. Mitchell Apr. 1986 13 p
(ARE-TM(UDP)-86102; ACCN-73371; BR99666; ETN-87-99464) Avail: NTIS HC A02/MF A01

The MASCOT 3 software engineering communication model, structural forms, and progressive definition are outlined. Only the main features of MASCOT 3 are highlighted, a more detailed study is being prepared. ESA

N87-21599# Royal Signals and Radar Establishment, Malvern (England).
TEN 15: AN OVERVIEW
P. W. Core and J. M. Foster Sep. 1986 43 p
(RSRE-MEMO-3977; BR101028; ETN-87-99474) Avail: NTIS HC A03/MF A01

Ten15 is a strongly typed, algebraic abstract machine used as the target machine of several compilers. The method of definition makes it possible to use formal techniques of algebra as a basis for tools. ESA

N87-21600# Royal Signals and Radar Establishment, Malvern (England).
AN EVALUATION OF THE FLEX PROGRAMMING SUPPORT ENVIRONMENT
M. Stanley Aug. 1986 37 p
(RSRE-86003; BR101371; ETN-87-99791) Avail: NTIS HC A03/MF A01

The Flex approach to program development necessary to take advantage of the environment is assessed, and the environment is assessed against criteria for programming environments in general. It is concluded that Flex performs well as a programming support environment. It is particularly suited for developing software prototypes and for testing new ideas on software methods and designs. Once a user has learned the Flex requirements, the system is easy to use. ESA

N87-21601# Royal Signals and Radar Establishment, Malvern (England).
INTEGRITY AND THE FLEX PROGRAMMING SUPPORT ENVIRONMENT
M. Stanley Jun. 1986 23 p
(RSRE-MEMO-3915; BR101213; ETN-87-99795) Avail: NTIS HC A02/MF A01

Special characteristics of the Flex programming support environment which result in a system of unusually high integrity are described. These characteristics include the capability mechanism, nonoverwriting filestore, and the use of procedures as first class objects. ESA

N87-21602# Royal Signals and Radar Establishment, Malvern (England).
TABULATED OUTPUT FROM ELLA
K. R. Milner Aug. 1986 12 p
(RSRE-MEMO-3966; BR101108; ETN-87-99797) Avail: NTIS HC A02/MF A01

An addition to the ELLA system, which takes the information stored by the simulator in a history file and outputs it in tabular form is described. Monitors are displayed horizontally and their values are tabulated against time, which runs vertically. ESA

N87-21603# Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.
A COORDINATE CONVERSION ALGORITHM FOR MULTISENSOR DATA PROCESSING
Eric M. Shank 5 Aug. 1986 46 p
(Contract DTFA01-84-Z-2-02030)
(AD-A176368; ATC-139; DOT/FAA/PM-86-37) Avail: NTIS HC A03/MF A01 CSCL 17/9

Processing of aircraft surveillance data form several geographically separated radars is most easily accomplished using a common coordinate system to represent data from all sensors. The Multisensor Data Processing system currently being developed for the FAA in support of the Advanced Automation System (AAS) requires a degree of accuracy and consistency that is not available from the current implementation of coordinate conversion. A study has been undertaken to design a coordinate conversion algorithm that meets the needs of Multisensor Data Processing. The process of projection of the ellipsoidal surface of the Earth onto a planar surface is examined in light of the requirements of air traffic control systems. The effects of the non-sperical nature of the Earth and of limited computational resources are considered. Several standard cartographic projection techniques are examined, and the stereographic projection is found to be the projection of choice. A specific implementation of stereographic projection that meets the needs of Multisensor Data Processing is described. This implementation makes use of several approximations to decrease the computational load. The systematic errors introduced by these approximations are removed by the addition of a correction term determined from the precomputed error surface. GRA

N87-21604# Massachusetts Inst. of Tech., Cambridge. Computer Science Lab.
THE X WINDOW SYSTEM
Robert W. Scheifler and Jim Gettys Oct. 1986 38 p
(Contract N00014-83-K-0125)
(AD-A176476; MIT/LCS/TR-368) Avail: NTIS HC A03/MF A01 CSCL 09/2

An overview of the X Window System is presented, focusing on the system substrate and the low-level facilities provided to build applications and to manage the desktop. The system provides high-performance, high-level, device-independent graphics. A hierarchy of resizeable, overlapping windows allows a wide variety of application and user interfaces to be built easily. Network-transparent access to the display provides an important degree of functional separation, without significantly affecting performance, that is crucial to building applications for a distributed environment. To a reasonable extent, desktop management can be custom tailored to individual environments, without modifying the base system and typically without affecting applications.
Author (GRA)

N87-21605# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
THE APPLICATION OF COMPUTER AIDED DESIGN (CAD) TECHNIQUES IN A ROUTE-PLANNING SYSTEM
H. J. Bos 19 Apr. 1985 12 p In DUTCH; ENGLISH summary Presented at the Congress on Design and Manufacturing using the Computer (CAPE 85 Netherlands), Amsterdam, The Netherlands, 1-3 May 1985
(NLR-MP-85039-U; ETN-87-99286) Avail: NTIS HC A02/MF A01

A computer system for the planning of aircraft routes is described. The user command language used to control the route-planning process is discussed. The storage, manipulation, and presentation of geographical information is explained, with emphasis on two different types of geographical information (structural and nonstructural map information). The use of combinations of both types of map information is presented. The workstation configuration is discussed. Practical experiences with the system are presented. ESA

N87-21606# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
INTRODUCTION TO THE DEVELOPMENT OF AUTOMATION PLANS FOR COMPUTER AIDED DESIGN/COMPUTER AIDED MANUFACTURING (CAD/CAM) IN MECHANICAL ENGINEERING
W. Loeve 23 Apr. 1985 19 p In DUTCH; ENGLISH summary Presented at the Congress on Design and Manufacturing using the Computer (CAPE 85 Netherlands), Amsterdam, The Netherlands, 1-3 May 1985
(NLR-MP-85042-U; ETN-87-99287) Avail: NTIS HC A02/MF A01

The functional hardware and software for CAD/CAM applications are described. The safeguarding of the coherence of information when computers are introduced for the processing of this information is explained. The development of automation plans for CAD/CAM is presented. ESA

N87-21607# Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany). Bereich Datenverarbeitung und Elektronik.
NILFIT: AN INTERACTIVE SYSTEM FOR NONLINEAR FIT OF DATA
Sabine Rothe May 1985 95 p In GERMAN; ENGLISH summary Revised; supersedes HMI-B336
(HMI-B431; D/M-172; HMI-B336; ETN-87-99331) Avail: NTIS HC A05/MF A01

An interactive program (NILFIT) used to fit experimental data by model curves, which depend on the curve parameters in a nonlinear way is described. The sample functions have to be programmed by the user and may be chosen arbitrarily during the execution. The fit is computed by various methods used to minimize nonlinear functions. The methods can be changed by dialog and their different parameter-lists are supplied by NILFIT. Statistical methods and graphical representations offer support in the search for minima and the assessment of the obtained results. ESA

N87-21608# Technische Hogeschool, Eindhoven (Netherlands).
COMPUTER AIDED DESIGN OF MAGNETIC DEFLECTION SYSTEMS Ph.D. Thesis
Anwar Osseyran 1986 175 p Submitted for publication
(ETN-87-99583) Avail: NTIS HC A08/MF A01

A design method of magnetic deflection yokes in cathode ray tubes, based on an accurate simulation of the deflection system and a systematic minimization of the aberrations within practical realization constraints and according to predefined specifications, is presented. The three dimensional deflection field calculations are based on the superposition of the incident field multipoles created by the deflection coils in free space and the magnetization field multipoles of the core. Ray-tracing is performed by solving the path equations of the electrons with a third order Runge-Kutta integration procedure, and raster and convergence errors are calculated at all the nodes of a grid defined on the screen. Encoding a design configuration and calculating all matrices used during the computation takes a few hours. Different prototypes were made according to the generated winding patterns at different stages of the optimization process, and accurate measurements of the magnetic field at the inner boundary at the picture tube profile were carried out. Flux density magnitudes inside the picture correlate from within 0.01% (near the tube axis) to 1% (near the tube boundary) of computed values. ESA

N87-21609# Research Inst. of National Defence, Linkoeping (Sweden). Dept. 3.
MORPHOLOGICAL TRANSFORMATIONS OF BINARY IMAGES
Roger Arnroth Dec. 1986 79 p
(FOA-30447-3.3; ISSN-0347-3708; ETN-87-99777) Avail: NTIS HC A05/MF A01; Research Institute of National Defence, Stockholm, Sweden KR50

Binary image processing was studied. An application program which implements filters on an image processing system was written. The filters represent well known algorithms. ESA

N87-21610# National Bureau of Standards, Gaithersburg, Md. Center for Programming Science and Technology.
GUIDANCE ON SOFTWARE PACKAGE SELECTION Final Report
S. Frankel Nov. 1986 124 p
(PB87-140810; NBS/SP-500/144) Avail: NTIS HC A06/MF A01; also available SOD HC $6.00 as 003-003-02773-1 CSCL 09B

The report describes a systematic procedure for identifying and evaluating off-the-shelf software packages, and for incorporating the selected package into the organizational environment. Its purpose is to enable the layperson to choose and implement software packages with a minimum of dependence on technical personnel. The report provides guidance on each phase of the package selection and implementation process. GRA

N87-21611# Office of Software Development, Falls Church, Va. Federal Software Testing Center.
PROGRAMMERS WORKBENCH HANDBOOK Final Report
Jun. 1986 36 p
(PB87-126942; OSDIT/FSMC-86/006) Avail: NTIS HC A03/MF A01 CSCL 09B

A practical approach to planning, acquiring, organizing, coordinating, and implementing automated tools is given. The spectrum of workbench concepts is given from individual tool selection and installation through sophisticated integration of software engineering data with high level automated tools is covered. The basic topics covered are (1) establishing the programmers workbench, (2) front-end integration of tools, (3) support function integration, and (4) fully integrated workbench. GRA

N87-21612# Environmental Protection Agency, Washington, D.C. Office of Information Resources Management.
INFORMATION SYSTEMS INVENTORY USER INSTRUCTION MANUAL
30 Sep. 1986 57 p
(PB87-131009; EPA/SW/DK-87/005A) Avail: NTIS HC A04/MF A01 CSCL 09B

The Information System Inventory User Instruction Manual provides a streamlined, step-by-step set of instructions on how to use the ISI. The manual takes the user from loading the system in a PC to describing how the ISI database is used. Detailed sections on the main menu, system flow chart, search capabilities and maintenance functions are also described. GRA

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N87-21613*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPLOITING LOOP LEVEL PARALLELISM IN NONPROCEDURAL DATAFLOW PROGRAMS Final Report
Maya B. Gokhale Apr. 1987 19 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178277; ICASE-87-23; NAS 1.26:178277) Avail: NTIS HC A02/MF A01 CSCL 09B

Discussed are how loop level parallelism is detected in a nonprocedural dataflow program, and how a procedural program with concurrent loops is scheduled. Also discussed is a program restructuring technique which may be applied to recursive equations so that concurrent loops may be generated for a seemingly iterative computation. A compiler which generates C code for the language described below has been implemented. The scheduling component of the compiler and the restructuring transformation are described. Author

N87-21614# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Datenverarbeitung in der Technik.
A MODELING AND SIMULATION TOOL FOR FAULT-TOLERANT DISTRIBUTED SYSTEMS APPLIED TO DISTRIBUTED DATABASE MANAGEMENT SYSTEMS Thesis - Technische Univ., Berlin, West Germany
Marek Leszak Sep. 1986 355 p In GERMAN; ENGLISH summary
(KfK-4138; ISSN-0303-4003; ETN-87-99334) Avail: NTIS HC A16/MF A01

A methodology for specification and performance prediction of fault-tolerant distributed systems is presented. The goal is to provide a tool supporting the design and evaluation of robust, higher layer communication protocols. A specification language based on high-level stochastic Petri nets is proposed, which is applicable to the description of complex hardware/software

systems. Specification of models using this net language, together with model execution by simulation, is supported by a software tool, which allows for automatic evaluation of performance measures. A method for integrated evaluation of performance and availabitity of fault-tolerant computer systems is presented. It yields overall performance comparisons of design alternatives by considering degraded performance after resource crashes. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N87-21615# Houston Univ., Tex. Dept. of Electrical Engineering.

STRUCTURE THEORIES AND APPLICATIONS OF MULTIVARIABLE CONTROL SYSTEMS DESCRIBED BY BLOCK CANONICAL FORMS Final Report, Sep. 1983 - Dec. 1986

Leang S. Shieh 1 Jan. 1987 11 p

(Contract DAAG29-83-K-0037)

(AD-A176482; ARO-20109.23-MA) Avail: NTIS HC A02/MF A01 CSCL 09/3

Several block canonical forms for describing a class of multivariable control systems have been developed in this project. Based on these canonical structures, some algebraic and geometric theories have been developed for analysis and design of multivariable control systems. Several matrix-valued functions have been defined and computational algorithms have been established for computing these matrix-valued functions. These matrix-valued functions and associated computational algorithms have been utilized for analysis and design of general large-scale continuous-time and discrete-time systems. Based on these research results, twenty-two papers have been published in the referenced journals. GRA

N87-21616# Naval Postgraduate School, Monterey, Calif.

REAL TIME PROGRAMMING OF A ROBOT M.S. Thesis

Paulo R. Souza Dec. 1986 118 p

(AD-A176782; AD-E900644) Avail: NTIS HC A06/MF A01 CSCL 09/3

Two difficulties that arise in controlling a robot arm (plant) are the changes in inertia and the lack of a velocity feedback. The inertia of the arm varies when the robot picks up or releases a load and the velocity would need a tachometer to be measured (expensive and not practical). One way to overcome those problems is to use an autoadaptive model to represent the plant. If the model follows the plant transfer function and both have the same input, the model can have velocity feedback and the effects will be reflected in the plant. The solution presented above was investigated and simulated in DSL by Kenneth R. Wikstrom, in his thesis from NPS in September of 1986. In the present research, a hardware and assembly software was designed and implemented based on the same structure mentioned in that thesis. The block diagram and autoadaptive algorithm were slightly modified and the plant was simulated in a dedicated analog computer. Two transfer functions were tested in the analog plant: a disk drive motor and a robot motor. GRA

N87-21617# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

QUANTITATIVE FEEDBACK THEORY (QFT): TECHNIQUE FOR DESIGNING MULTIVARIABLE CONTROL SYSTEMS Final Report

C. H. Houpis Jan. 1987 214 p

(AD-A176883; AFWAL-TR-86-3107) Avail: NTIS HC A10/MF A01 CSCL 09/4

The report satisfies the desire of practicing engineers and students to have one document that presents the Quantitative Feedback Theory (QFT) technique in a unified and logical manner. QFT is a unified theory using the available measurable states that are applied to the design of multiple-input, multiple-output (MIMO) systems. It incorporates the multivariable nature of control systems plant uncertainties, wide variations versus time of plant parameters, robustness performance requirements, disturbance attention requirements, nonlinearities in the plant model, and requirements for decoupled outputs. GRA

N87-21618# Oak Ridge National Lab., Tenn.

VIRTUAL-TIME OPERATING-SYSTEM FUNCTIONS FOR ROBOTICS APPLICATION ON A HYPERCUBE

J. R. Einstein, J. Barhen, and D. Jefferson 1986 10 p Presented at the 2nd Conference on Hypercube Multiprocessors, Knoxville, Tenn., 29 Sep. 1986

(Contract DE-AC05-84OR-21400)

(DE87-003658; CONF-8609173-8) Avail: NTIS HC A02/MF A01

Hypercube multiprocessors used in autonomous robots carrying out time-critical tasks in unpredictable environments require special operating-system functions to provide the capability of rapid response to unforeseen external events. A virtual-time shell having such capabilities is under design for the Vertex operating system of the NCUBE hypercube computer. DOE

N87-21619# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.

A FLEXIBLE, COMPUTER-INTEGRATED ROBOTIC TRANSFER SYSTEM

W. I. Lewis, III and R. M. Taylor 1987 16 p Presented at the Robotics 2 Conference, Chicago, Ill., 26 Apr. 1987

(Contract DE-AC09-76SR-00001)

(DE87-004183; DP-MS-86-85; CONF-870474-1) Avail: NTIS HC A02/MF A01

This paper reviews a robotic system used to transport materials across a radiation control zone and into a row of shielded cells. The robot used is a five-axis GCA 600 industrial robot mounted on a 50-ft ESAB welding track. Custom software incorporates the track as the sixth axis of motion. An IBM-PC integrates robot control, force sensing, and the operator interface. Multiple end-effectors and a quick exchange mechanism are used to handle a variety of materials and tasks. Automatic error detection and recovery is a key aspect of this system. DOE

N87-21620# Oak Ridge National Lab., Tenn.

INTELLIGENT OPERATING SYSTEMS FOR AUTONOMOUS ROBOTS: REAL-TIME CAPABILITIES ON A HYPERCUBE SUPER-COMPUTER

J. R. Einstein, J. Barhen, and D. Jefferson 1986 7 p Presented at the International Topical Meeting on Remote Systems and Robotics in Hostile Environments, Pasco, Wash., 29 Mar. 1987 Prepared in cooperation with California Univ., Los Angeles

(Contract DE-AC05-84OR-21400)

(DE87-004076; CONF-870301-14) Avail: NTIS HC A02

Autonomous robots which must perform time-critical tasks in hostile environments require computers which can perform many asynchronous tasks at extremely high speeds. Certain hypercube multiprocessors have many of the required attributes, but their operating systems must be provided with special functions to improve the capability of the system to respond rapidly to unpredictable events. A virtual-time shell, under design for addition to the Vertex operating system of the NCUBE hypercube computer, and having such capabilities, is described. DOE

N87-21621# National Aerospace Lab., Amsterdam (Netherlands).

ARTIFICIAL INTELLIGENCE TECHNIQUES FOR WORKING WITH KNOWLEDGE

J. C. Donker 13 Jun. 1985 51 p In DUTCH; ENGLISH summary Submitted for publication

(NLR-MP-85037-U; ETN-87-99285) Avail: NTIS HC A04/MF A01

Concepts related to the field of artificial intelligence are surveyed. A short history of research in this field is presented. Knowledge based systems and expert systems are treated. Perspectives of knowledge based systems are given. The empty expert system-shell DELFI is used as an illustration. ESA

N87-21622# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
PROVIDING KNOWLEDGE BY MEANS OF ARTIFICIAL INTELLIGENCE TECHNIQUES: EXPERIENCES AND DEVELOPMENTS AT THE NATIONAL AEROSPACE LABORATORY (NLR)
J. C. Donker 1 Nov. 1985 10 p In DUTCH; ENGLISH summary Presented at NGI/SIC Conference 'Expertsystemen', Utrecht, The Netherlands, 16 Dec. 1985
(NLR-MP-85081-U; ETN-87-99296) Avail: NTIS HC A02/MF A01

Pilot investigations were carried out in order to familiarize aerospace research personnel with knowledge engineering techniques; an empty expert system shell was used to gain experience. This led to the implementation of the shell on the main frame (Cyber 180/855), and the introduction to users. As a result of the exercises, requirements regarding this type of system were formulated. ESA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N87-21623 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
DATA APPROXIMATION BY SPLINES IN ONE AND TWO INDEPENDENT VARIABLES
M. G. Cox Oct. 1986 28 p Presented at the Joint IMA/SIAM Conference on the State-of-the-Art in Numerical Analysis, Birmingham, England, 14-18 Apr. 1986
(NPL-DITC-77/86; ISSN-0262-5369; ETN-87-99475) Copyright. Avail: Issuing Activity

Developments in data approximation by univariate and bivariate splines, particularly B-splines, are reviewed. The use and advantages of methods other than the traditional minimum norm solution in determining least squares bivariate spline approximants to scattered data sets; and the value of curved knot lines, in terms of which tensor product splines have the potential to handle a much wider range of practical problems are discussed. Approximation norms, constrained approximation, and the determination of statistical information associated with least squares spline approximants are considered. ESA

N87-21624# Royal Aircraft Establishment, Farnborough (England).
ORIGINAL IMPROVEMENTS OF THE TLM METHOD
M. Leroy Apr. 1986 8 p Transl. into ENGLISH from Electronics Letters (France), v. 17, no. 19, 1981 p 684-685
(RAE-Trans-2151) Avail: NTIS HC A02/MF A01

The use of the three-dimensional TLM method is limited, firstly, by an excessive computation time and, secondly, by the variability of the results when the position of the point of origin varies. an original approach is described which improves the first point and avoids the second one. The resonant frequencies of the studied cavity are computed by applying Prony's method to time variations of the electric energy located inside the cavity. Numerical results are given in the case of the ridged waveguide cavity. Author

N87-21625*# Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
THE BINARY WEIGHT DISTRIBUTION OF THE EXTENDED (2 SUP m, 2 SUP m-4) CODE OF REED-SOLOMON CODE OVER GF(2 SUP m) WITH GENERATOR POLYNOMIAL (x-ALPHA SUP 2) (x-ALPHA SUP 3)
Shu Lin 1 May 1987 19 p
(Grant NAG5-407)
(NASA-CR-180510; NAS 1.26:180510) Avail: NTIS HC A02/MF A01 CSCL 12A

Consider an (n,k) linear code with symbols from GF(2 sup m). If each code symbol is represented by a binary m-tuple using a certain basis for GF(2 sup m), a binary (nm,km) linear code called a binary image of the original code is obtained. A lower bound is presented on the minimum weight enumerator for a binary image of the extended (2 sup m, 2 sup m -4) code of Reed-Solomon code over GF(2 sup m) with generator polynomical (x - alpha)(x-alpha squared)(x - alpha cubed) and its dual code, where alpha is a primitive element in GF(2 sup m). Author

N87-21626# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
ON LEARNING BOOLEAN FUNCTIONS Interim Report
B. K. Natarajan Dec. 1986 17 p
(AD-A176516; CMU-RI-TR-86-17) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper deals with the learnability of boolean functions. An intuitive appealing notion of dimensionality of boolean functions is developed and used to identify the most general class of boolean function families that are learnable from polynominally many positive examples with one-sided error. It is then argued that although bounded DNF expressions lie outside this class, they must have efficient learning algorithms as they are well suited for expressing many human concepts. A framework that enables efficient learning of bounded DNF functions is then identified. Author (GRA)

N87-21627# Oxford Univ. (England). Dept. of Engineering Science.
SOME COMPUTATIONAL RESULTS ON SIZE REDUCTION IN H SUP INF DESIGN
I. Postlethwaite, D.-W. Gu, and S. D. OYoung 1986 30 p Sponsored by UK Science and Engineering Research Council
(OUEL-1648/86; ETN-87-99458) Avail: NTIS HC A03/MF A01

Results on the solution to the algebraic Riccati equation are presented. The results lead to a numerically stable algorithm for reducing the size of R bar in the model-matching problem min/Q member of H sup inf // R bar - Q bar // inf. which is the central computational step in the H sup inf design procedure. For the 1-block problem, which arises when Q bar has neither zero rows nor zero columns, explicit formulae for a minimal realization of R bar are obtained. ESA

N87-21628# Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany). Bereich Datenverarbeitung und Elektronik.
A METHOD FOR THE CONSTRUCTION OF CONTINUOUSLY DIFFERENTIABLE SURFACES FOR THE INTERPOLATION OF SCATTERED DATA
Rita Schmidt and Martina Steinfeld Jun. 1986 105 p In GERMAN; ENGLISH summary
(HMI-B371; D/M-131; ETN-87-99330) Avail: NTIS HC A06/MF A01

An interpolation method which consists of triangulating the set of nodes and connecting piecewise cubic polynominals, defined over each triangle, interpolating the given data in the corners, and matching the cubic polynominals and their normal derivatives on common edges is described. The method is global and needs no further information beyond the scattered data. ESA

N87-21629# Technische Hogeschool, Delft (Netherlands).
A CLASS OF INTEGRAL TRANSFORMS AND ASSOCIATED FUNCTION SPACES Ph.D. Thesis
Adrianus Schuitman 1986 174 p
(ETN-87-99575) Avail: NTIS HC A08/MF A01

Function spaces, T and S, which by the Mellin transform and its inverse are mapped onto each other are constructed. The spaces of type S are such that two of them are mapped onto each other by the map m1(K) and its inverse. The relation (*) is translated into a diagram, T1, T2, S1 and S2 being function spaces. It is shown that the diagram under certain conditions is commutative and that there are additional conditions which allow to reverse the direction of the arrows, thus giving a decomposition for one side. For the convolution transform, a similar construction is developed. In applications, functions which are arbitrarily often differentiable are of great interest. If operations with functions are in the picture, going to, limit, near and so on are also important. Therefore function spaces of infinitely often differentiable functions, supplied with some topology, are analyzed. Spaces S and T are

constructed in such a way that they become locally convex vector spaces. Extensions of the theory to distributions via the dual spaces and maps are easy to construct. ESA

N87-21630# Technische Hogeschool, Eindhoven (Netherlands).
THE ESTIMATION OF PARAMETERS IN FUNCTIONAL RELATIONSHIP MODELS Ph.D. Thesis
Leo Thomas Maria Emmanuel Hillegers 1986 179 p
(ETN-87-99586) Avail: NTIS HC A09/MF A01

Relationship models and errors of observation are introduced, and the estimating equations are reviewed. Linear and nonlinear functional relationship models, and linear structural relationship models are presented. Functional relationship models with a more complex structure are shown. Phase separation in a polymer-solvent mixture is analyzed. ESA

N87-21631# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
CUBIC INTERPOLATED PSEUDO-PARTICLE (CIP): A NEW NUMERICAL SOLVER FOR GENERAL NONLINEAR HYPERBOLIC EQUATIONS IN MULTIDIMENSION
Takashi Yabe (Osaka Univ., Suita, Japan) and Hideaki Takewaki (Fujitsu Ltd., Tokyo, Japan) Dec. 1986 70 p
(KfK-4154; ISSN-0303-4003; ETN-87-99652) Avail: NTIS HC A04/MF A01

A cubic-interpolated pseudo-particle method to solve hyperbolic equations on vector machines is proposed. The method gives a stable and less diffusive result for square wave propagation compared with flux-corrected transport and a better result for propagation of a sine wave with a discontinuity. The scheme is extended to nonlinear and multidimensional problems. ESA

N87-21632# Rome Univ. (Italy). Dipt. di Fisica.
THE GAUGE FIELD COPIES AND BACKLUND TRANSFORMATION
Ziemowit Popowicz (Wroclaw Univ., Poland) 13 Jun. 1986 7 p Submitted for publication
(Preprint-513; ETN-87-99730) Avail: NTIS HC A02/MF A01

It is explicity shown that the auto Backlund transformation and nonauto Kruskal-Dodd-Bullough transformation for the Sine-Gordon equation can be interpreted as the gauge field copies for the strength tensor associated with the Lax pair for the Sine-Gordon equation. The auto and nonauto Backlund transformation for the Liouville equation is interpreted in the same way. The concept of the pseudocopies of Law pair is introduced. ESA

N87-21633# Rome Univ. (Italy). Dipt. di Fisica.
HIERARCHIES OF INTEGRABLE EQUATIONS OBTAINED AS NONISOPECTRAL (IN X AND T) DEFORMATIONS OF THE SCHROEDINGER SPECTRAL PROBLEM
D. Levi 12 Sep. 1986 8 p Submitted for publication
(Preprint-522; ETN-87-99737) Avail: NTIS HC A02/MF A01

The usual procedure for constructing hierarchies of integrable equations corresponding to nonisospectral deformations of a spectral problem is extended to the case when the spectral parameter depends also on x. As an example, the case of the Schroedinger spectral problem is considered. Two possible hierarchies of equations, one corresponding to lambda = x+z(t), which contains as a particular case the cylindrical Korteweg-de Vries equation, and a second to lambda = 2/xsq+z(t) are obtained. ESA

N87-21634# Rome Univ. (Italy). Dipt. di Fisica.
ON A NEW DARBOUX TRANSFORMATION FOR THE CONSTRUCTION OF EXACT SOLUTIONS OF THE SCHROEDINGER EQUATION
D. Levi 12 Sep. 1986 14 p Submitted for publication
(Preprint-523; ETN-87-99738) Avail: NTIS HC A02/MF A01

A Darboux transformation to get solutions of the Schroedinger equation in the case when the potential diverges asymptotically is presented. The cases of a linearly divergent potential, a quadratically divergent potential, and a potential with a double pole in the origin are considered. ESA

N87-21635# Rome Univ. (Italy). Dipt. di Fisica.
NONLINEAR EVOLUTION EQUATIONS, RESCALINGS, MODEL PARTIAL DIFFERENTIAL EQUATIONS (PDE'S) AND THEIR INTEGRABILITY, 1
Francesco Calogero and Wiktor Eckhaus (Utrecht State Univ., Netherlands) 19 Sep. 1986 30 p Submitted for publication
(Preprint-524; ETN-87-99739) Avail: NTIS HC A03/MF A01

Wave-modulation for a large and quite general class of nonlinear evolution equations is studied. It is shown that only a very limited number of universal model equations, on relevant time and space scales, describe the phenomena of interest under all circumstances. Under certain conditions, modulations already occur on shorter time and space scales than those relevant for the nonlinear Schroedinger equation (NLS). If by cancellation of terms NLS becomes linear, then appropriate model equations live on longer time and space scales. The limited number of model equations suggests that they should have wide applicability. The analysis consists of Fourier decomposition followed by rescalings and appropriate limits. If integrability properties are inherited through such limit procedures, then the model equations should be integrable under a wide range of conditions. Investigation of integrability properties largely confirms this expectation. ESA

N87-21636# Rome Univ. (Italy). Dipt. di Fisica.
THE OCTET NONLEPTONIC HAMILTONIAN AND CURRENT ALGEBRA ON THE LATTICE WITH WILSON FERMIONS
Luciano Maiani, Guido Martinelli (European Organization for Nuclear Research, Geneva, Switzerland), Giancarlo Rossi, and Massimo Testa (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 22 Sep. 1986 60 p Submitted for publication Sponsored by the Italian Ministry of Education
(Preprint-525; ETN-87-99740) Avail: NTIS HC A04/MF A01

It is shown how chiral symmetry works on the lattice, and chiral Ward identities in the massless quark limit are discussed. Ward identities in the massive case are worked out to discuss the ambiguities inherent in the definition of chiral operators, and the connection to soft-pion theorems. The structure of the subtractions to the relevant four fermion operators is presented. The explicit procedure to compute the physical weak transition amplitudes is outlined. ESA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N87-21637# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
MULTIVARIATE ANALYSIS AND ITS APPLICATIONS Annual Report, 1 Oct. 1985 - 30 Sep. 1986
P. R. Krishmaiah 30 Sep. 1986 13 p
(Contract F49620-85-C-0008)
(AD-A177019; AFOSR-87-0070TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

During the period of October 1, 1985 to September 30, 1986, research work was done in the areas of signal processing, quality control, reliability and survival analysis, time series, characterization problems, robustness of test procedures, nonparametric estimation of density, pattern recognition, contingency tables, detection of outliers, selection of important variables, and multivariate distribution theory. About 40 technical reports were written during the above period. The work done under the present contract has many important applications in the problems of interest to the DOD. For example, they have applications in manufacturing technology, automation, expert systems, pattern recognition and machine intelligence, etc. GRA

N87-21638# Rome Univ. (Italy). Dipt. di Fisica.
ON THE UPPER CRITICAL DIMENSION IN ANDERSON LOCALIZATION
C. Castellani (Aquila Univ., Italy), C. DiCastro, and L. Peliti

(Eidgenoessische Technische Hochschule, Zurich, Switzerland) 27 Jun. 1986 13 p Submitted for publication
(Preprint-514; ETN-87-99731) Avail: NTIS HC A02/MF A01

It is shown that the anomalous scaling behavior of the moments of the wavefunction at the threshold of the Anderson localization implies a log-normal distribution for the probability psi sq at first order in epsilon = d-2. It is suggested that the upper critical dimension of the Anderson localization is infinity. ESA

N87-21639# Rome Univ. (Italy). Dipt. di Fisica.
INTERMITTENCY AS MULTIFRACTALITY IN HISTORY SPACE
G. Paladin, L. Peliti, and A. Vulpiani 4 Sep. 1986 14 p Submitted for publication
(Preprint-518; ETN-87-99733) Avail: NTIS HC A02/MF A01

Temporal intermittency in a chaotic dynamical system is regarded as a manifestation of the multifractal properties of the set of histories. The Renyi entropies Kq which generalize the Kolmogorov entropy K1 play a role analogous to the exponents Tau(q) characterizing the scaling properties of the moments of the mass distribution. The topological entropy h(lambda) of the subset of histories with the same local expansion parameter is introduced. It is shown that Kq and h(lambda) are related to each other by means of a Legendre transformation. ESA

N87-21640# Rome Univ. (Italy). Dipt. di Fisica.
THE MULTIFRACTAL NATURE OF STRANGE ATTRACTORS AND TURBULENCE [LA NATURA MULTIFRATTALE DEGLI ATTRATORI STRANI E DELLA TURBOLENZA]
Giovanni Paladin 15 Jan. 1987 130 p In ITALIAN Submitted for publication
(Preprint-539; ETN-87-99754) Avail: NTIS HC A07/MF A01

Renyi dimensions are introduced to describe the structure of the natural probability measure generated in relation to a chaotic attractor and a numerical algorithm developed to compute it. It is shown chaotic attractors are typically fractal objects. The statistical properties of developed turbulence with space periodicity in energy dissipation are studied showing that the intermittency may be modeled using fractals with Df less than 3. The measurement of time intermittency using indexes extracted from experimental data such as the Renyi entropy or Lyapunov generalized exponents are discussed. A multifractal approach to the transfer matrix describing the localization of the wave function of the Schroedinger equation is also presented. ESA

N87-21641# National Bureau of Standards, Boulder, Colo.
STARPAC: THE STANDARD TIMES SERIES AND REGRESSION PACKAGE
J. R. Donaldson and P. V. Tryon Jan. 1987 309 p
(PB87-152385; NBSIR-86-3448) Avail: NTIS HC A14/MF A01 CSCL 12A

STARPAC, the Standards Time Series and Regression Package, is a library of FORTRAN subroutines for statistical data analysis developed by the Statistical Engineering Division (SED) of the National Bureau of Standards (NBA), Boulder, Colorado. Earlier versions of this library were distributed by the SED under the name STATLIB (Tryon and Donaldson, 1978). STARPAC incorporates many changes to STATLIB, including additional statistical techniques, improved algorithms and enhanced portability. STARPAC emphasizes the statistical interpretation of results, and, for this reason, comprehensive printed reports of auxiliary statistical information, often in graphical form, are automatically provided to augment the basic statistical computations performed by each user-callable STARPAC subroutine. STARPAC thus provides the best features of many stand-alone statistical software programs within the flexible environment of a subroutine library. GRA

N87-21468# European Space Agency, Paris (France).
ACCURACY AND ERROR ANALYSIS
Jean Skudridakis *In its* Proceedings of Meteorological Motor Glider (MEMO) Workshop '84 (ESA-TT-945) Nov. 1986 p 163-192 Transl. into ENGLISH from "Beitrag zum Workshop MEMO (Meteorologischer Motorsegler)" DFVLR, Oberpfaffenhofen, West Germany, report DFVLR-Mitt-85-04, Jan. 1985 p 161-194 Original language document was announced as N85-35557 (For primary document see N87-21453 14-47)
Avail: NTIS HC A10/MF A01; original German version available from DFVLR, Cologne, West Germany DM 53

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N87-21642# Lawrence Livermore National Lab., Calif.
INDUCTION LINEAR ACCELERATOR TECHNOLOGY FOR SDIO APPLICATIONS
D. Birx, L. Reginato, D. Rogers, and D. Trimble Nov. 1986 19 p Presented at the 9th International Conference on Application of Accelerators in Research and Industry, Denton, Tex., 10 Nov. 1986
(Contract W-7405-eng-48)
(DE87-003251; UCRL-95317; CONF-861114-32) Avail: NTIS HC A02/MF A01

The research effort reported concentrated primarily on three major activities. The first was aimed at improvements in the accelerator drive system of an induction linac to meet the high repetition rate requirements of SDI applications. The second activity centered on a redesign of the accelerator cells to eliminate the beam breakup instabilities, resulting in optimized beam transport. The third activity sought to improve the source of electrons to achieve a higher quality beam to satisfy the requirement of the free electron laser. DOE

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N87-21643# Rome Univ. (Italy). Dipt di Fisica.
THE RELEVANCE OF CONNECTANCE ON THE LYAPUNOV CHARACTERISTIC EXPONENTS OF PRODUCTS OF SYMPLECTIC RANDOM MATRICES
Giovanni Paladin and Angelo Vulpiani 4 Sep. 1986 10 p Submitted for publication
(Preprint-519; ETN-87-99734) Avail: NTIS HC A02/MF A01

The effect of the connectance on the Lyapunov characteristic exponents of products of symplectic random matrices which mimic the chaotic behavior of a large class of Hamiltonian systems is studied. It is shown that no significant modifications appear in the spectrum of the Lyapunov characteristic exponents when the number of interacting neighbors is increased. ESA

N87-21644# Rome Univ. (Italy). Dipt. di Fisica.
SYMMETRIES AND BI-HAMILTONIAN STRUCTURES OF 2+1 DIMENSIONAL SYSTEMS
P. M. Santini and A. S. Fokas (Clarkson Univ., Potsdam, N.Y.) 12 Dec. 1986 19 p Presented at the 1986 Oberwolfach Conference on the Nonlinear Evolution Equations, Solitons and the Inverse Scattering Transform Submitted for publication
(Preprint-536; ETN-87-99751) Avail: NTIS HC A02/MF A01

The theory associated with the recursion operators of classes of integrable nonlinear evolution equations in 2+1 dimensions is summarized. The notions of symmetries, gradients of conserved quantities, strong and hereditary symmetries, and Hamiltonian operators are generalized to equations in multidimensions. Applications to physically relevant equations like the Kadomtsev-Petviashvili equation are illustrated. Integro-differential evolution equations like the Benjamin-Ono equation are shown to be also described by this generalized theory. ESA

N87-21645# Rome Univ. (Italy). Dipt. di Fisica.
INTEGRABLE 2+1 DIMENSIONAL EQUATIONS, THEIR RECURSION OPERATORS AND BI-HAMILTONIAN STRUCTURES AS

REDUCTION OF MULTIDIMENSIONAL SYSTEMS
P. M. Santini 23 Jan. 1987 18 p Presented at the Rencontre Interdisciplinaire-Problemes Inverses, Montpellier, France, 1986 Submitted for publication
(Preprint-540; ETN-87-99755) Avail: NTIS HC A02/MF A01

Multidimensional equations are derived from the compatibility condition between linear operators. The algebraic properties associated with their recursion operators and bi-Hamiltonian structures are summarized. A dimensional reduction is used to derive known integrable equations in 2+1 dimensions like the Kadomtsev-Petviashvili equation; the main aspects of the theory associated with their recursion and bi-Hamiltonian operators are also obtained through this reduction procedure. ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N87-21646# National Academy of Sciences - National Research Council, Washington, D. C. Commission on Physical Sciences Mathematics and Resources.
PHYSICS AT THE LASER-ATOMIC FRONTIER Final Report
1986 65 p
(Contract DE-FG05-85ER-13326; Grant NSF PH4-85-1040)
(PB87-126611) Avail: NTIS HC A04/MF A01 CSCL 20C

Laser-based research is one of the most rapidly developing areas in the field of atomic, molecular, and optical physics. The many scientific opportunities and the broad impact of this research on neighboring sciences and federal and industrial programs made this a natural subject for inclusion in Selected Opportunities in Physics, a research briefing that was prepared at the request of the Office of Science and Technology Policy and the National Science Foundation. To portray the opportunities described in the briefing, the Committee on Atomic and Molecular Science (CAMS) of the National Research Council sponsored a workshop on the Laser-Atomic Frontier, which was held at the National Academy of Sciences on October 11, 1985. The presentations of that workshop are documented. Topics discussed include the following: the new spectroscopies; light under control - a new generation of radiation sources; trapped and laser-cooled particles; intense electromagnetic fields in laser-atomic interactions; laser science in industry; national programs at the laser-atomic frontier; and laser-atomic research in universities. GRA

N87-21647# Admiralty Research Establishment, Portland (England).
ON THE NUMERICAL MODELLING OF A MAGNETIC SOURCE
A. G. Theobald Jul. 1986 73 p
(ARE-TR-86113; ACCN-73823; BR100866; ETN-87-99463) Avail: NTIS HC A04/MF A01

A numerical magnetic source model which reproduces a given set of magnetic field measurements to any desired degree of accuracy is derived from first principles. The model is a combination of independent discrete and continuous distributions of independent multipoles of arbitrary order, and is particularly suitable for use with sources with a large length to breadth/height ratio; for example, a ship. Most variables in the model are linear, and so are easily optimized. The derivatives of the field equations with respect to the nonlinear terms are given so that these terms also may readily be optimized. The mathematics, specific for a source comprised of dipoles (continuous and discrete), only, is also included. ESA

N87-21648# Tel-Aviv Univ. (Israel). Faculty of Exact Sciences.
THE FRONTIERS OF PHYSICS (THE NEXT 25 YEARS)
Y. Neeman 1986 12 p
(Contract DE-FG05-85ER-40200)
(DE87-004329; DOE/ER-40200/054; TAUP/P-48) Avail: NTIS HC A02/MF A01

Advances on both the small (quantum world) and large (cosmological) frontiers throughout this century are reviewed. Plausible targets for the next 25 years for physics research are presented. DOE

N87-21649# National Bureau of Standards, Gaithersburg, Md.
JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, VOLUME 91, NUMBER 4, JULY-AUGUST 1986
Aug. 1986 84 p
(PB87-109864) Avail: NTIS HC A05/MF A01; also available SOD HC $3.00 as 703-027-00011-3 CSCL 20C

The contents of this report are as follows: Calibration of Beta-Particle Ophthalmic Applicators at the National Bureau of Standards; Room Temperature Gold-Vacuum-Gold Tunneling Experiments; Conference on Precision Electromagnetic Measurements. GRA

N87-21650# National Bureau of Standards, Gaithersburg, Md.
JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, VOLUME 91, NUMBER 6, NOVEMBER-DECEMBER 1986
Dec. 1986 56 p
(PB87-137154) Avail: NTIS HC A04/MF A01 CSCL 20C

The report includes the following: The temperature dependence of spectral broadening in the Hg (6 singlet S(sub 0)6 triplet P(Sub 1)) Multiplet at high optical densities; Absolute isotopic abundance ratio and atomic weight of a reference sample of gallium; Thermal expansion of platinum and platinum-rhodium alloys. GRA

N87-21651# National Bureau of Standards, Gaithersburg, Md. Center for Basic Standards.
TECHNICAL ACTIVITIES 1986, CENTER FOR BASIC STANDARDS
P. L. M. Heydemann Oct. 1986 340 p
(PB87-140315; NBSIR-86/3469) Avail: NTIS HC A15/MF A01 CSCL 20C

The report summarizes the research and technical activities of the Center for Basic Standards during the Fiscal Year 1986. These activities include work in the areas of electricity, temperature and pressure, mass and length, time and frequency, quantum metrology, and quantum physics. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environment Pollution.*

N87-21652* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACOUSTIC GUIDE FOR NOISE-TRANSMISSION TESTING OF AIRCRAFT Patent
Rimas Vaicaitis, inventor (to NASA) (Columbia Univ., New York) Issued 24 Feb. 1987 9 p Filed 3 Jul. 1985 Supersedes N86-30086 (24 - 10, p 1663)
(NASA-Case-LAR-13111-1-CU; US-Patent-4,644,794;
US-Patent-Appl-SN-751695; US-Patent-Class-73-583;
US-Patent-Class-73-589; US-Patent-Class-73-599) Avail: US Patent and Trademark Office CSCL 20A

Selective testing of aircraft or other vehicular components without requiring disassembly of the vehicle or components was accomplished by using a portable guide apparatus. The device consists of a broadband noise source, a guide to direct the acoustic energy, soft sealing insulation to seal the guide to the noise source and to the vehicle component, and noise measurement microphones, both outside the vehicle at the acoustic guide output and inside the vehicle to receive attenuated sound. By directing acoustic energy only to selected components of a vehicle via the acoustic guide, it is possible to test a specific component, such as a door or window, without picking up extraneous noise which may be transmitted to the vehicle interior through other components or structure. This effect is achieved because no acoustic energy strikes the vehicle exterior except at the selected component.

Also, since the test component remains attached to the vehicle, component dynamics with vehicle frame are not altered.
Official Gazette of the U.S. Patent and Trademark Office

N87-21653*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACOUSTIC RADIATION STRESS MEASUREMENT Patent
John H. Cantrell, Jr. and William T. Yost Issued 17 Mar. 1987 6 p Filed 13 Sep. 1985 Supersedes N86-22307 (24 - 12, p 2025)
(NASA-Case-LAR-13440-1; US-Patent-4,649,750; US-Patent-Appl-SN-775989; US-Patent-Class-73-599; US-Patent-Class-73-1-DV) Avail: US Patent and Trademark Office CSCL 20A

Ultrasonic radio frequency tone-bursts are launched into a sample of material tested. The amplitude of the tone-bursts and the slope of the resulting static displacement pulses are measured. These measurements are used to calculate the nonlinearities of the materials.
Official Gazette of the U.S. Patent and Trademark Office

N87-21654# Admiralty Research Establishment, Teddington (England).
TEST OF FORTRAN PROGRAM FOR SOUND SCATTERING BY LAYERED SPHERE
N. J. White Oct. 1986 23 p
(ARE-TM(UHA)-86518; BR100809; ETN-87-99465) Avail: NTIS HC A02/MF A01

The FORTRAN program ONION used to calculate the target strength of a layered sphere whose elements are represented by the exact linear equations of acoustics, elastodynamics, and viscodynamics is described. Single and double precision versions are available on a VAX-11/785 computer. Numerical results of sound scattering, by an empty/water-filled steel sphere with/without an outer compliant coating, demonstrate that the program is a useful research tool ESA

N87-21655# Chase (David M.), Inc., Boston, Mass.
MODELING TURBULENCE-INDUCED NOISE WITH APPLICATION TO NOISE CONTROL Final Report
David M. Chase 30 Dec. 1986 9 p
(Contract N00014-80-C-0730)
(AD-A176417; CHASEINC/CR87-11(ONR)) Avail: NTIS HC A02/MF A01 CSCL 20/1

Following cessation of effort concerned with development of a nonlinear dynamical model of wall turbulence, recent research was directed to topics related to fluid/structure interactions. A topic of considerable interest has been the production of low-wavenumber pressure and sound radiation by deformation of a compliant surface bounding a turbulent flow, operating via the nonlinear convolving of the turbulent wall pressure and response at convective wave-numbers. Some results have also been obtained regarding certain classical and prosaic model acoustic problems that are nevertheless useful in self-noise analyses. GRA

N87-21656# National Aerospace Lab., Amsterdam (Netherlands). Structures Dept.
IRREGULAR MODES IN A DUCT WITH AN IMPEDANCE WALL
S. W. Rienstra 4 Dec. 1985 16 p In DUTCH; ENGLISH summary Presented at the Dutch Acoustic Society on Flow Noise, Utrecht, The Netherlands, 11 Sep. 1985
(NLR-MP-85086-U; ETN-87-99298) Avail: NTIS HC A02/MF A01

The appearance of acoustic modes of irregular behavior in a duct with an impedance wall is explained. Cases with and without a uniform mean flow were considered. At high frequencies these modes become surface waves, exponentially confined to the wall region. The various domains of existence in the impedance and axial wave number phase are given. Without mean flow there is one left and one right-running wave. With mean flow there are three downstream running waves, one of which is unstable, and one upstream running wave. ESA

N87-21657# National Aerospace Lab., Amsterdam (Netherlands). Structures Dept.
SOME ASPECTS OF FAN NOISE GENERATION IN AXIAL COMPRESSORS
J. B. H. M. Schulten Dec. 1985 21 p In DUTCH; ENGLISH summary Presented at the Dutch Acoustic Society on Flow Noise, Utrecht, The Netherlands, 11 Sep. 1985
(NLR-MP-85089-U; ETN-87-99299) Avail: NTIS HC A02/MF A01

Sound generation by the interaction of velocity disturbances and stator vanes was theoretically investigated using a lifting surface approach. In this model the effect of vane lean on the sound field generated by a typical stator exposed to the disturbances of the viscous wake system of a rotor were considered. It is found that, in contrast to earlier speculations, even a moderate amount of vane lean increases the acoustic power considerably. It is shown that, at frequencies prevailing in current turbofans, even a small vane stagger angle significantly affects the sound generation process. The physical origin of both phenomena is discussed. ESA

N87-21658# National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.
EVALUATION OF OFF-AXIS MEASUREMENTS PERFORMED IN AN ANECHOIC CHAMBER
M. Kanda and J. C. Wyss Oct. 1986 42 p
(PB87-134367; NBS/TN-1305) Avail: NTIS HC A03/MF A01; also available SOD HC $2.25 as SN003-003-02779-1 CSCL 20A

Field strength versus distance from various source antennas is measured in a rectangular rf anechoic chamber on axes parallel to the boresight axis. An electrically small field probe is repeatedly scanned longitudinally away from the launch antenna and into the chamber. With each scan various parameters are changed, including: (1) horizontal and vertical position of the probe with respect to the center line of the launch antenna; (2) frequency; and (3) type of launch antenna. With the probe located 1 m off the center line and scanning between 2 and 6 m from the launch horn, the uncertainty due to being off the center line ranges from plus or minus 1 dB at 250 MHz to plus or minus 5.0 dB at 800 MHz and above. If the probe is within plus or minus 50 cm of center line, the uncertainty is no more than plus or minus 1.5 dB at 800 MHz; and, for plus or minus 25 cm from center line the uncertainty is further reduced to plus or minus 0.5 dB at 800 MHz. GRA

N87-21659# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
VERSATILE THREE-DIMENSIONAL HAMILTONIAN RAY-TRACING PROGRAM FOR ACOUSTIC WAVES IN THE ATMOSPHERE ABOVE IRREGULAR TERRAIN
R. M. Jones, J. P. Riley, and T. M. Georges Aug. 1986 423 p
(PB87-115804) Avail: NTIS HC A18/MF A01 CSCL 20A

HARPA stands for Hamiltonian Acoustic Ray-tracing Program for the Atmosphere. The FORTRAN computer program traces the three-dimensional paths of acoustic rays through model atmospheres by numerically integrating Hamilton's equations, which are a differential expression of Fermat's principle. The user specifies an atmospheric model by writing closed-form formulas for its three-dimensional wind and temperature (or sound-speed) distribution, and by defining the height of the reflecting terrain as a function of geographic latitude and longitude. Some general-purpose models are provided, or users can easily design their own. The report describes the ray-tracing equations and the structure of the program and provides complete instructions for using it, illustrated by a sample case. The program is modular and can be adapted to model propagation through other media by changing the routine that defines the medium's dispersion relation. GRA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N87-21660* National Aeronautics and Space Administration. Pasadena Office, Calif.

GENERATION OF INTENSE NEGATIVE ION BEAMS Patent

Ara Chutjian, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena), Otto J. Orient, inventor (to NASA), and Samuel H. Aladzhadzhyan, inventor (to NASA) Issued 10 Mar. 1987 9 p Filed 2 May 1985 Supersedes N85-29701 (23 - 18, p 3178)

(NASA-Case-NPO-16061-1-CU; US-Patent-4,649,278; US-Patent-Appl-SN-729768; US-Patent-Class-250-423-R; US-Patent-Class-250-424; US-Patent-Class-250-427; US-Patent-Class-250-288; US-Patent-Class-313-359.1; US-Patent-Class-313-361.1; US-Patent-Class-313-362.1) Avail: US Patent and Trademark Office CSCL 20H

An electron gun is used with a mirror electrostatic field to produce zero or near zero velocity electrons by forming a turning point in their trajectories. A gas capable of attaching zero or near zero velocity is introduced at this turning point, and negative ions are produced by the attachment or dissociative attachment process. Operation may be continuous or pulsed. Ions thus formed are extracted by a simple lens system and suitable biasing of grids.

Official Gazette of the U.S. Patent and Trademark Office

N87-21661* National Aeronautics and Space Administration. Pasadena Office, Calif.

VARIABLE ENERGY, HIGH FLUX, GROUND-STATE ATOMIC OXYGEN SOURCE Patent

Ara Chutjian, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena) and Otto J. Orient, inventor (to NASA) Issued 10 Mar. 1987 12 p Filed 10 Apr. 1986 Supersedes N86-27055 (24 - 17, p 2809)

(NASA-Case-NPO-16640-1-CU; US-Patent-4,649,273; US-Patent-Appl-SN-852468; US-Patent-Class-250-251; US-Patent-Class-250-396-R; US-Patent-Class-250-423-P; US-Patent-Class-376-127) Avail: US Patent and Trademark Office CSCL 20H

A variable energy, high flux atomic oxygen source is described which is comprised of a means for producing a high density beam of molecules which will emit O(-) ions when bombarded with electrons; a means of producing a high current stream of electrons at a low energy level passing through the high density beam of molecules to produce a combined stream of electrons and O(-) ions; means for accelerating the combined stream to a desired energy level; means for producing an intense magnetic field to confine the electrons and O(-) ions; means for directing a multiple pass laser beam through the combined stream to strip off the excess electrons from a plurality of the O(-) ions to produce ground-state O atoms within the combined stream; electrostatic deflection means for deflecting the path of the O(-) ions and the electrons in the combined stream; and, means for stopping the O(-) ions and the electrons and for allowing only the ground-state O atoms to continue as the source of the atoms of interest. The method and apparatus are also adaptable for producing other ground-state atoms and/or molecules.

Official Gazette of the U.S. Patent and Trademark Office

N87-21662# Stanford Univ., Calif. Physics Lab.

RESEARCH ON CRYOGENIC VACUUM TUNNELING Annual Report, 1 Aug. 1985 - 31 Jul. 1986

C. F. Quate Dec. 1986 42 p

(Contract N00014-84-K-0549)

(AD-A176390; GL-4133) Avail: NTIS HC A03/MF A01 CSCL 20/2

The Scanning Tunneling Microscope has been immersed in liquid helium and used to image the surface of graphite with atomic resolution. The instrument has been reduced in size and this makes it possible to scan at high rates and to operate without a system for vibration isolation. It has been possible to record the phonon spectrum of graphite and the vibrational spectra of sorbic acid using the miniaturized instrument. GRA

N87-21663# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.

JOINT PRODUCTION OF phi MESONS AND pi(+,-), pi(0), rho, rho bar, K(0)S AND K(+,-) IN HADRONIC INTERACTIONS

H. Dijkstra, R. Bailey (Science Research Council, Chilton, England), E. Belau (Max-Planck-Inst. fuer Physik und Astrophysik, Munich, West Germany), T. Boehringer (European Organization for Nuclear Research, Geneva, Switzerland), M. Bosman, V. Chabaud, C. Damerell (Science Research Council, Chilton, England), C. Daum, G. deRijk, S. Gill et al Mar. 1986 15 p Submitted for publication

(NIKHEF-H/86-2; B8669202; ETN-87-99592) Avail: NTIS HC A02/MF A01

The joint production of phi mesons and pi(+,-) pi(0), rho, rho bar, K(0)S and K(+,-) was investigated using a sample of 600,000 inclusive phi meson events obtained in hadron Be interactions with incident pi(+,-), rho, rho bar, and K(+,-) beams. Evidence for the joint production of phi mesons and strange particles produced with nonstrange incident beams is presented. With incident K(+,-) beam the number of additional strange particles is supressed. The results are found to be in agreement with the qualitative predictions of a parton fusion model. The comparison with the Lund model for low pT processes is fair. ESA

N87-21664# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.

SUPERMULTIPLETS IN HILBERT SPACE FOR THE SUPERSYMMETRIC BAG MODEL

Yue Zong-wu Jan. 1986 13 p

(NIKHEF-H/86-5; B8669203; ETN-87-99593) Avail: NTIS HC A02/MF A01

It is shown in the quasiclassical approximation that the off-shell supermultiplets of the supersymmetric bag model can be constructed merely according to the intuitive rule (changing a creation operator into its supersymmetric partner). It is demonstrated how to form the candidate on-shell supermultiplets to be used as the trial vectors for the variational method. The energy expression for an on-shell supermultiplet (a set of composite particles) of the model is given. ESA

N87-21665# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.

GANTRAS: A SYSTEM OF CODES FOR THE SOLUTION OF THE MULTIGROUP TRANSPORT EQUATION WITH A RIGOROUS TREATMENT OF ANISOTROPIC NEUTRON SCATTERING. PLANE AND SPHERICAL GEOMETRY

Aleksandra Schwenk-Ferrero Nov. 1986 114 p Sponsored by the IAEA

(KfK-4163; ISSN-0303-4003; ETN-87-99654) Avail: NTIS HC A06/MF A01

A system of codes for neutron transport calculations in which the anisotropy of elastic and inelastic (including (n,n'x)-reactions) scattering is fully taken into account was developed. This is achieved by employing a rigorous method, so-called l*-method, to represent the scattering term of the transport equation and with the use of double-differential cross-sections for the description of the emission of secondary neutrons. The l*-method was incorporated into the conventional transport code ONETRAN. The ONETRAN subroutines were modified. An implementation of the updated version ANTRA1 was accomplished for plane and spherical geometry; ANTRA1 was included in GANTRAS and linked to modules which prepare angle-dependent transfer matrices. ESA

N87-21666# Rome Univ. (Italy). Dipt di Fisica.

NEUTRAL MESON DECAYS AND THE ANNIHILATION CONTRIBUTION

M. Lusignoli and A. Pugliese 10 Jul. 1986 21 p Submitted for publication

(Preprint-515; ETN-87-99732) Avail: NTIS HC A02/MF A01

The contribution to D(0) decays due to the possible existence

of a resonance with a mass near to the D(0) mass and having the quantum numbers of the K bar meson is considered. Improvement in the prediction for exclusive decays and for D(0) decays to pseudoscalar and vector mesons is shown. ESA

N87-21667# Rome Univ. (Italy). Dipt. di Fisica.
THE PRODUCTION OF WEAK INTERMEDIATE BOSONS IN ELECTRON-POSITRON REACTIONS
Emidio Gabrielli 31 Jul. 1986 16 p Submitted for publication
(Preprint-520; ETN-87-99735) Avail: NTIS HC A02/MF A01

The calculations of production cross sections of W and Z(0) bosons in e-p reactions at HERA energies and beyond are revised. Comparison with previous calculations shows that in some cases the cross sections were considerably overestimated. The effects of a possible deviation of the W anomalous magnetic moment from the standard model value are also discussed. ESA

N87-21668# Rome Univ. (Italy). Dipt. di Fisica.
LIGHT GLUINOS AND FIXED TARGET EXPERIMENTS
G. Penso and S. Petrarca 24 Sep. 1986 10 p Submitted for publication
(Preprint-526; ETN-87-99741) Avail: NTIS HC A02/MF A01

Light gluino production cross sections in pi p and pp interactions, and missing energy distribution were calculated for a calorimetry beam dump experiment. The effect of experimental cuts combined with the gluino fragmentation is discussed and compared with collider experiments. It is suggested that the window for light gluinos can be explored with a fixed target calorimetry experiment, using multi TeV hadron beams. This type of experiment does not suffer from criticity. ESA

N87-21669# Rome Univ. (Italy). Dipt. di Fisica.
MASSLESS HIGGS BOSON IN SOFTLY BROKEN SUPERSYMMETRIC THEORIES
E. Franco and A. Morelli 26 Sep. 1986 56 p Submitted for publication
(Preprint-528; ETN-87-99743) Avail: NTIS HC A04/MF A01

The Higgs sector of a model with a softly broken supersymmetry is studied. In contrast to the standard nonsupersymmetric model, the stability of the vacuum does not impose any lower bound to the Higgs mass. ESA

N87-21670# Rome Univ. (Italy). Dipt. di Fisica.
STATUS OF THE ELECTROWEAK THEORY
G. Altarelli 13 Oct. 1986 22 p Presented at the 23rd International Conference on High Energy Physics, Berkeley, California, 16-23 Jul. 1986 Submitted for publication
(Preprint-529; ETN-87-99744) Avail: NTIS HC A02/MF A01

The physics of electroweak interactions is reviewed. Two extreme scenarios are envisaged. The first can be denoted as the standard way beyond the standard model: the Higgs is elementary, it is rather light so that perturbation theory is valid up to M(GUT) or M(Planck) and naturality is restored by supersymmetry. For this, Susy partners should be discovered below the few TeV energy domain. At least two Higgs doublets are needed, which implies the existence of charged and neutral physical scalars. The chances of one Higgs at low mass are then even larger. In simple models there is a tendency for one neutral Higgs to be lighter than the Z(0). The other extreme could be that the Higgs particle is not found below the TeV energy scale where the weak interactions become nonperturbative (composite Higgs and compositeness in general lean on this side). The gap between the Fermi and the Planck scale is then essentially not accessible to the present theory. ESA

N87-21671# Rome Univ. (Italy). Dipt. di Fisica.
SEARCHING FOR AN INTERMEDIATE MASS HIGGS BOSON AT LARGE ENERGY e+e-, LINEAR COLLIDERS
G. Altarelli and E. Franco 6 Oct. 1986 18 p Submitted for publication
(Preprint-530; ETN-87-99745) Avail: NTIS HC A02/MF A01

Production and detection via its quark-antiquark decay mode of a Higgs boson with mass Mw less than mh less than 300 GeV in e(+)e(-) reactions with root s = 1 to 2 TeV is studied. Contrary to the case of p-p large energy colliders, it is found that for realistic values of the experimental resolution the signal over background ratio is sufficient for detection in most cases. ESA

N87-21672# Rome Univ. (Italy). Dipt. di Fisica.
HEAVY HIGGS PRODUCTION AT FUTURE COLLIDERS
G. Altarelli, B. Mele, and F. Pitolli 6 Oct. 1986 39 p Submitted for publication
(Preprint-531; ETN-87-99746) Avail: NTIS HC A03/MF A01

The WW and ZZ mechanisms for production of heavy Higgs bosons are studied. The exact analytic distribution Ek. d sigma/d cubed k with k being the Higgs momentum is derived. The rapidity and transverse momentum distributions of the Higgs, which are important for the experimental reconstruction of the Higgs signal through its decay products, are obtained. The relation between the exact results and approximations for the total cross section and the kt distribution are discussed. Numerical applications to e(+)e(-), e(-)p, and pp reactions in the TeV or multi TeV energy domain are presented. ESA

N87-21673# Rome Univ. (Italy). Dipt. di Fisica.
MAGNETIC MOMENTS OF MULTIQUARK STATES AND LIMIT ON THE SIX-QUARK BAG ADMIXTURE IN THE DEUTERON WAVE FUNCTION
L. Kondratyuk, M. Schepkin, and M. Krivoruchenko 8 Jan. 1987 22 p Submitted for publication
(Preprint-537; ETN-87-99752) Avail: NTIS HC A02/MF A01

Using the chiral bag model and taking into account pion and gluon corrections, the magnetic moment of six-quark bag with quantum numbers of deuteron is calculated. For the radius of six-quark bag R6q=1.16 to 1.38 fm which corresponds to the bag radius of nucleon R3q=0.8+1.0 fm, MD6q=1.17 to 1.23 nm. Data on deuteron magnetic moments are used to obtain the limit on a six-quark bag admixture in deuteron: PB less than 3%. The result for PB 3% is smaller by a factor 3 to 5 than the probability to find nucleons in deuteron at a distance (1476) 1.4 fm, and apparently indicates that properties of an effective bag in deuteron are quite different from those of MIT six-quark bag. The influence of the 6q-bag admixture on the deuteron quadrupole moment is discussed. ESA

N87-21674# Rome Univ. (Italy). Dipt. di Fisica.
HEAT TRANSPORT AND EFFECTIVE LANDAU FERMI LIQUID PARAMETERS IN DISORDERED INTERACTING ELECTRONIC SYSTEMS
C. Castellani, C. DiCastro, and G. Strinati 28 Jan. 1987 14 p Submitted for publication
(Preprint-542; ETN-87-99756) Avail: NTIS HC A02/MF A01

The renormalization of the specific heat and of the thermal diffusion coefficient due to the electron-electron interaction in the presence of disorder, is determined by exploiting the skeleton structure of the heat response function in conjunction with the constraints originating from energy conservation (in the form of a Ward identity). This analysis leads to a generalization of the Wiedemann-Franz law near the localization transition with inclusion of interaction effects. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N87-21675# Oak Ridge National Lab., Tenn.
ASSESSMENT OF CERAMIC COMPOSITES FOR MULTIMEGAWATT SPACE NUCLEAR POWER SYSTEMS
T. M. Besmann Dec. 1986 24 p
(Contract DE-AC05-84OR-21400)
(DE87-005272; ORNL/TM-10267) Avail: NTIS HC A02/MF A01

A calculational thermodynamic equilibrium analysis of the compatibility of ceramic-ceramic composites and a nonequilibrium assessment based on the literature of their use in proposed multimegawatt space nuclear power systems was performed. The five candidate composites included Al O- reinforced Al O, SiC-whisker-toughened Al O, SiC-whisker-toughened Si N, SiC-fiber-reinforced ZrC, and carbon-fiber-reinforced ZrC. The reactor concepts included Brayton cycle (continuous and burst mode) and Rankine cycle. It was determined that Al O- reinforced Al O and carbon-fiber-reinforced ZrC are compatible in the Brayton-cycle continuous-mode system and that Al O- reinforced Al, SiC-fiber-reinforced ZrC, and carbon-fiber-reinforced ZrC are compatible in the Rankine-cycle system. None of the candidate ceramic composite systems was likely to be sufficiently stable under Brayton-cycle burst-mode conditions. DOE

N87-21676# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.

SC CORRECTION COILS AND MAGNETS FOR THE HERA PROTON RING

C. Daum, J. Geerinck, H. Moeller (Deutsches Elektronen-Synchrotron, Hamburg, West Germany), R. Heller, P. Schmueser (Hamburg Univ., West Germany), and P. Bracke May 1986 7 p (NIKHEF-H/86-10; B8669204; ETN-87-99594) Avail: NTIS HC A02/MF A01

The design, manufacture and performance of correction elements of the HERA proton ring is described. The quadrupole and sextupole correction coils are mounted on the cold beam pipe inside the main dipole magnets. Superferric dipole magnets for orbit correction are located adjacent to the main quadrupole magnets in a common cryostat which also contains the beam monitor. ESA

N87-21677# Kernforschungszentrum, Karlsruhe (West Germany). Hauptabteilung Ingenieurtechnik.

BEHAVIOR OF UO2 AND FISSIUM IN SODIUM VAPOR ATMOSPHERE AT TEMPERATURES UP TO 2800 C

H. Feuerstein and J. Oschinski Nov. 1986 35 p Presented at the International Conference on Nuclear and Radiochemistry, Beijing, China, 1-5 Sep. 1986

(KfK-4135; ISSN-0303-4003; ETN-87-99650) Avail: NTIS HC A03/MF A01

An experimental technique was developed to study the behavior of fuel and fission products in out-of-pile tests in a sodium vapor atmosphere. Evaporation rates of UO2 were measured up to 2800 C. The evaporation is found to depend on temperature and the active surface. Evaporation restructures the surface of the samples, however no new active surface is formed; UO2 can form well shaped crystals and curious erosion products. The efficiency of the used condenser/filter lines is $>$ 99.99%. In an HCDA, all the evaporated substances condense in the sodium pool. Thermal reduction of the UO2 reduces the oxygen potential of the system. The final composition at 2500 C is UO1.95. The only influence of the sodium vapor is found for the diffusion of UO2 into the thoria of the crucible. Compared with experiments in an atmosphere of pure argon, the diffusion rate is reduced. ESA

N87-21678# Rome Univ. (Italy). Dipt. di Fisica.

SCHOOL AND THE NUCLEAR ENERGY PROBLEMS: PRELIMINARY ANALYSIS OF A QUESTIONNAIRE [LA SUCOLA E I PROBLEMI DEL NUCLEARE: ANALISI PRELIMINAIRE DELL RISPOSTE AD UN QUESTIONARIO]

A. M. Conforto, L. Danusso, and C. Signorini 13 Nov. 1986 24 p In ITALIAN Submitted for publication

(Nota-Interna-873; ETN-87-99766) Avail: NTIS HC A02/MF A01

The feelings of Italian secondary school and university students toward the utilization of nuclear energy were explored, questioning 600 students aged 16 to 24. The study was carried on in 85/86, that is before the Chernobyl accident. The results show a relatively low level of knowledge about natural and radiation phenomena, and a weak correlation between atomic war possibility which is feared, and the attitude towards the pacific uses of atomic energy. ESA

74 OPTICS

N87-21679* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OPTICAL SCANNER Patent

Mitchell W. Finkel, inventor (to NASA) Issued 3 Mar. 1987 11 p Filed 2 May 1984 Supersedes N84-25450 (22 - 15, p 2407

(NASA-Case-GSC-12897-1; US-Patent-4,647,144; US-Patent-Appl-SN-606432; US-Patent-Class-350-6.5) Avail: US Patent and Trademark Office CSCL 20F

An optical scanner for imaging lines in an object plane onto a linear array in a focal plane either continuously or discretely is described. The scanner consists of a set of four mutually perpendicularly oriented plane corner mirrors which provide a reflecting path that describes a parallelogram. In addition, there is a plane parallel scanning mirror with a front and back reflecting surface located midway between the first and fourth corner mirrors. It is oriented so that in the mid-scan position it is parallel to the first corner mirror, and therefore perpendicular to the fourth corner mirror. As the scan mirror rotates, rays incident from a plurality of lines in the object plane are selectively directed through the optical system arriving at a common intersection on the back surface of the scanning mirror where the rays are colinearly directed toward a lens and then imaged onto the linear array in the focal plane. A set of compensating mirrors may be introduced just before the imaging lens to compensate for a small and generally negligible path difference delta sub I between the axial and marginal rays.

Official Gazette of the U.S. Patent and Trademark Office

N87-21680# Royal Signals and Radar Establishment, Malvern (England).

INVESTIGATION INTO THE CHARACTERISTICS OF ZnSe FILTERS

M. S. Hazell, M. F. Lewis, and C. L. West Nov. 1986 24 p

(RSRE-MEMO-3993; BR101464; ETN-87-99799) Avail: NTIS HC A02/MF A01

Experiments were performed to assess zinc selenide interference filters for the demonstration of optical bistability. Most of the measurements were made on the original batch of samples and show damage when cycled for periods greater than 20 min. Techniques developed to access and observe this damage are described. ESA

N87-21681# California Univ., Santa Barbara. Dept. of Electrical and Computer Engineering.

USE OF DEPLETION-EDGE TRANSLATION FOR HIGH SPEED MODULATION AND SWITCHING OF LIGHTWAVES: YEAR-1 Annual Report, 1 Aug. 1985 - 31 Jul. 1986

Larry A. Coldren, A. Alping, X. S. Wu, T. R. Hausken, and T. C. Huang Oct. 1986 26 p

(Grant AF-AFOSR-0323-85)

(AD-A176839; AFOSR-87-0151TR) Avail: NTIS HC A03/MF A01 CSCL 17/2

This report describes a new device concept for optical modulators and switches. Application may be found in optical communication, IC interconnection and optical computing. The basic concept involves combining and maximizing several effects that can occur in the depletion region of a semiconductor pn junction to change the index of refraction therein. As a reverse bias is applied to properly designed device, the depletion region gets wider and in the index shift within it gets larger relative to the surrounding material. The result is that more efficient, compact and potentially higher speed devices can be realized, since most optical modulation and switching concepts rely upon a change in the index of refraction in some region. Initial results have shown a three-fold increase in the phase shifting efficiency (phase shift per unit length per volt) of simple phase modulators as compared to any previously published material. GRA

N87-21682# EG and G Energy Measurements, Inc., Los Alamos, N. Mex.

AMPLITUDE-INDEPENDENT FIBER-OPTIC PRESSURE SENSOR Final Report
D. Macy and R. M. Malone Dec. 1986 45 p
(Contract DE-AC08-83NV-10282)
(DE87-003873; EGG-10282-5022) Avail: NTIS HC A03/MF A01

A Fiber-Optic Pressure Sensor (FOPS) is described, which is a light-amplitude independent instrument for detecting displacement of a pressure-activated diaphragm. The FOPS is used to measure static pressure via a single multimode fiber link in areas with high electrical interference. The sensor and its theory of operation are described, as well as its calibration, multiplexing, and fielding.DOE

N87-21683# Oak Ridge Gaseous Diffusion Plant, Tenn.
LIQUID-CORE FIBER OPTICS: TRANSMISSION AND NONLINEAR EFFECTS
S. W. Allison, M. R. Cates, and G. T. Gillies (Virginia Univ., Charlottesville) Dec. 1986 18 p Presented at the International Congress on Applications of Lasers and Electro Optics, Washington, D.C., 1 Nov. 1986 Prepared in cooperation with Virginia Univ., Charlottesville
(Contract DE-AC05-84OT-21400)
(DE87-005960; K/TS-11811; CONF-8611137-1) Avail: NTIS HC A02/MF A01

Previous research on liquid-core fiber optics is surveyed. These waveguides exhibit a number of interesting characteristics which are of use to sensing, spectroscopy, and communications. Liquid-core optical fibers are discussed in regard to applications involving high-peak-power transmission of laser light. The roles of liquid properties, nonlinearities, and fiber-to-waveguide coupling are discussed. The self-healing capability of such a waveguide following laser-induced breakdown is demonstrated. DOE

N87-21186# Sandia National Labs., Albuquerque, N. Mex.
SAPPHIRE FIBER OPTIC TEMPERATURE PROBE
D. A. Tichenor, K. R. Hencken, and R. W. Bickes, Jr. *In* AGARD Advanced Instrumentation for Aero Engine Components Nov. 1986 5 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N87-21684*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
PLASMA PHYSICS ABSTRACTS, 1 JANUARY - 31 DECEMBER, 1986
D. A. Gurnett, N. DAngelo, and C. K. Goertz 5 May 1987 20 p
(Grant NGL-16-001-043)
(NASA-CR-180220; NAS 1.26:180220) Avail: NTIS HC A02/MF A01 CSCL 20I

Topics addressed include: ion-cyclotron waves; plasma waves; solar wind lithium releases; bow shock; Pi2 wave bursts; auroral kilometric radiation; ion energization; magnetic field corrections; electric fields; magnetospheric processes; electron acceleration; inner heliosphere; nightside auroral zone; computerized simulation; plasma wave turbulence; and magnetohydrodynamic waves in plasma sheets. B.G.

N87-21685# Naval Research Lab., Washington, D. C.
THE INTERCHANGE INSTABILITY IN HIGH-LATITUDE PLASMA BLOBS
P. K. Chaturvedi and J. D. Huba 30 Dec. 1986 38 p
(AD-A176242; NRL-MR-5895) Avail: NTIS HC A03/MF A01 CSCL 04/1

The stability of high latitude plasma density enhancements (blobs) is analyzed with regard to the interchange model (driven by a neutral wind or transverse electric field acting on the density gradient at the walls of the blobs). The effects arising from the finite parallel length of the blobs along the magnetic field lines are included in the analysis. Plasma regions of differing collisionalities, to which the blobs extend in altitude, are considered. It is found that the finite-parallel blob size results in a modest reduction in the growth rates of the small (somewhat less than 1 km) and intermediate (1-10 km) scale sizes, but severely reduces the growth rates, for the large scale sizes (greater than 10 kms) for the observed parallel blob lengths (approx. 300-600 kms). Further, it is found that the instability growth rates show a moderate reduction at higher altitudes (where ion-inertial effects may be dominant over the ion neutral collisional effects). Thus, the E x B instability is considered a plausible candidate for the scintillation causing irregularities (1-10 kms) associated with the high latitude blobs. GRA

N87-21686# Los Alamos National Lab., N. Mex.
SPECTRAL SIGNATURES FROM SHORT-PULSE MICROWAVE AIR BREAKDOWN
W. T. Armstrong, R. A. Roussel-Dupre, R. Karl, M. I. Buchwald, and G. Graham 1986 20 p Presented at the American Physical Society Plasma Physics Division Meeting, Baltimore, Md., 3 Nov. 1986
(Contracts W-7405-eng-36; DE-AC08-83NV-10282)
(DE87-006116; CONF-861110-6-Vugraphs) Avail: NTIS HC A02/MF A01

Air breakdown N2 + signatures are studied over a range of air pressures from 0.4 to 150 Torr. Short microwave pulses of frequency 3 GHz, approx. 6 ns duration and approx. 0.5 GW peak power are focused to produce air breakdown in a pressure cell region removed from walls. Diagnostics include microwave power measurements, spectroscopy, photometry and CCD imaging. Spectral signature variation with pressure, in addition to breakdown phenomenology, is discussed. DOE

N87-21687# Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes (France).
ELLIPSOMETRIC AND PHOTOLUMINESCENT CHARACTERIZATION OF H2 AND N2 MULTIPOLAR PLASMA INTERACTIONS WITH THE 100 GaAs CRYSTAL SURFACE Ph.D. Thesis - Institut National des Sciences Appliquees de Lyon, France [CARACTERISATION IN SITU PAR ELLIPSOMETRIE ET PHOTOLUMINESCENCE DE L'INTERACTION DE PLASMAS MULTIPOLAIRES D'HYDROGENE ET D'AZOTE AVEC LA SURFACE (100) DE GAAS]
Daniel Arnoult 1986 149 p In FRENCH Sponsored by DESTI
(INSA-IDI-186-05; ETN-87-99409) Avail: NTIS HC A07/MF A01

Passivation techniques for MESFET devices are investigated. Hydrogen plasma deoxidation and N2 plasma nitriding in ultrahigh vacuum are studied. Ellipsometric, photoluminescent, and spectroscopic characterization techniques are discussed and the measuring instruments are described. The experimental design permitted verification of the role played by the plasma density on the quality of the surface and the temperature effects on the nitriding kinetics. ESA

N87-21688# Technische Hogeschool, Eindhoven (Netherlands).
NONEQUILIBRIUM IN FLOWING ATMOSPHERIC PLASMAS Ph.D. Thesis
Johannes Cornelis Maria deHaas 1986 148 p
(ETN-87-99587) Avail: NTIS HC A07/MF A01

Cesium seeded argon plasma in a closed cycle MHD generator, and thermal argon plasma in a cascade arc with an imposed flow were investigated. The influence of non-equilibrium on the mass and energy balances of a plasma was analyzed. A general theory was derived, and applied to both the plasma in an MHD generator and to the cascade arc with imposed flow. Experimental investigations of the plasma of a closed cycle MHD generator concentrated on the dimensions of the filaments which are present in such a plasma. For the cascade arc flow, the plate voltages, the mass flow, and the pressure at the entrance of the channel were measured. ESA

N87-21689# Netherlands Energy Research Foundation, Petten.
FUSION TECHNOLOGY PROJECTS Progress Report, 1985

J. D. Elen, comp. May 1986 112 p
(ECN-185; B8671613; ETN-87-99604) Avail: NTIS HC A06/MF A01

The protection of the first wall by ceramic coatings against melting by plasma disruptions was studied. The compilation of a European Fusion File of nuclear data in its first version is presented. The activations of neutron flux monitors for the JET neutron diagnostics system were recalculated using a 3D model of the torus and its D-shaped plasma. Results of low cycle fatigue and tensile testing of the reference heat of stainless steel 316 L are reported. The design of a 12 Tesla niobium-tin insert coil for the SULTAN test facility is described, including the start of its conductor development. The results of irradiation of ceramic lithium compounds for tritium breeding are presented. ESA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N87-21690# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
DIFFUSION AND DEFECT CHARACTERIZATION OF MERCURY CADMIUM TELLURIDE Semiannual Progress Report, 1 Feb. - 31 Jul. 1986
D. A. Stevenson 31 Jul. 1986 6 p
(Contract N00014-84-K-0423; DARPA Order 5019)
(AD-A176323) Avail: NTIS HC A02/MF A01 CSCL 20/2

The diffusion studies in the present report period have emphasized the experimental determination of interdiffusion at lower temperatures (less than 450 C) and the modeling of the defect chemistry of Mercury Cadmium Telluride (MCT) in order to explain both interdiffusion results and the electrical behavior of MCT. In addition, there is continuing progress on the tracer diffusion studies in MCT. In the crystal growth portion of the program, most of the effort has been devoted to the analysis of previous work. Work continues on the experimental study of isothermal liquid phase epitaxy (ISOLPE) and on electrochemical studies. GRA

N87-21691# IBM Watson Research Center, Yorktown Heights, N.Y.
SYNCHROTRON RADIATION STUDIES OF MBE-GROWN SEMICONDUCTOR AND METAL SURFACES AND INTERFACES Final Report, 1 Oct. 1983 - 30 Sep. 1986
Rudolf Ludeke 8 Dec. 1986 60 p
(Contract DAAG29-83-C-0026)
(AD-A176445; ARO-19030.12-EL) Avail: NTIS HC A04/MF A01 CSCL 20/12

The work for the contract period addressed the physics and chemistry underlying the formation of the electronic structure at semiconductor oxide and semiconductor metal interfaces. Using photoemission spectroscopy a new oxidation model has been proposed for GaAs and InP. Extensive studies of transition metals deposited on GaAs and InP led to the first concrete identification of interface states responsible for the formation of the Schottky barrier, namely d-derived impurity levels of transition metal atoms in the semiconductor. GRA

N87-21692# Tampere Univ. of Technology (Finland).
APPLICATION OF THE ALE AND MBE METHODS TO THE GROWTH OF LAYERED Hg SUB 1-X Cd SUB X Te FILMS Interim Report
Markus Pessa 26 Jun. 1986 5 p
(Contract DAJA45-84-C-0051)
(AD-A176797; IR-5) Avail: NTIS HC A02/MF A01 CSCL 20/2

Molecular Beam Epitaxial growth of Hg1-ICdITe films of 8 x 8 sq mm in size has been carried out at high mercury concentration with I ranging from 0.2 to 0.4 for various samples. Most of the films are deposited onto semi-insulating 2 deg off (100) GaAs substrates on which a CdTe buffer layer of 0.5-2 to micrometer is first grown. The films are single crystals exhibiting a (100) orientation in most cases (occasionally a (111) orientation is observed, too). Film thickness is varied from 500 nm to 2 micrometer. A diffusion barrier cap of 20 nm is deposited on top of this layered structure. Infrared absorption spectra are measured for a few selected samples. An absorption spectrum and growth parameters of a sample are shown. The absorption edge appears at the wavelength of about 8.5 micrometer. GRA

N87-21693# Scientific Research Associates, Inc., Glastonbury, Conn.
THREE-DIMENSIONAL NUMERICAL STUDIES OF THE PHYSICS OF SEMICONDUCTOR CRYSTAL GROWTH Final Report, 1 Aug. 1983 - 30 Sep. 1986
Y. T. Chan, H. J. Gibeling, N.-S. Liu, and H. L. Grubin Feb. 1987 118 p
(Contract N00014-83-C-0510)
(AD-A176808; SRA-R-920018-F) Avail: NTIS HC A06/MF A01 CSCL 20/12

The present study involves the development and application of a numerical technique to the most popular method of growing silicon crystal - the Czochralski process. The equations solved for the melt phase are the conservation equations for the mass, momentum, energy and nonreacting species. For the crystal phase, the energy balance equation is solved. The governing equations are formulated using primitive variables and are not thereby restricted to two dimensional symmetry. The crystal and melt phases are coupled through thermal conditions applied along the melt crystal interface. The shape of the melt crystal interface and meniscus are determined through solutions to differential equations that govern the kinematic conditions at the specific interfaces, and are not assumed a priori. The numerical procedures are obtained by a well documented procedure known as the consistently split Linearized Block Implicit (LBI) scheme, originally developed at SRA. Calculations, including one three dimensional case, are performed for various growth conditions suitable for silicon crystal growth. The present study has successfully demonstrated the numerical capabilities for Czochralski crystal growth simulations. GRA

N87-21694# Northwestern Univ., Evanston, Ill. Dept. of Physics.
SUPERLATTICE EFFECTS IN GRAPHITE INTERCALATION COMPOUNDS Final Report, 1 Oct. 1984 - 30 Nov. 1986
R. S. Markiewicz 18 Dec. 1986 33 p
(Contract F49620-82-C-0076)
(AD-A176879; AFOSR-87-0123TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

The research was motivated by the observation of anomalous mixing frequencies in the deHaas-van Alphen spectra of graphite intercalation compounds. An analysis was made concentrating on compounds containing Bromine, which has extremely large anomalies. Three sources can produce these anomalies: (1) In many of our original samples, the very strong magnetic torques caused the samples to tilt in a magnetic field, and led to a torque instability, causing discontinuous jumps of sample position and hysteresis. (2) In rigidly mounted samples, interband transfer causes significant lineshape distortion, which can be quantitatively accounted for by a simple theory. This theory confirms that the intercalation compound behaves as a true two-dimensional hose gas, with energy gaps between successive Landau levels. (3) Condon domain formation, a phase transition within the electron gas, remains the most intriguing possibility. It is shown that in two-dimensions it is closely related to the quantum Hall effect. While this mechanism has not yet been observed, it can now be predicted in which intercalation compounds it will appear. GRA

N87-21695# Wisconsin Univ., Madison.
VORTICES IN LONG JOSEPHSON JUNCTIONS Annual Report, Nov. 1985 - Nov. 1986
James E. Nordman and James B. Beyer Dec. 1986 13 p
(Grant AF-AFOSR-0025-86)

(AD-A176916; AFOSR-87-0152TR; AR-1) Avail: NTIS HC A02/MF A01 CSCL 20/12

Research during the initial year of this grant concentrated on fabrication and modelling of long Josephson junction structures. A particular effort was made to understand the basic operating mechanisms of a type of superconducting transistor, the vortex flow transistor, and to optimize its circuit performance. Fabrication techniques were developed using niobium and lead superconductors. These techniques allow rapid production of a variety of device shapes. An optimization of geometric configuration was made to produce the most desirable device characteristics. Amplification was observed at low frequencies and initial coupling circuit designs were made to enable high frequency measurement. Development of potentially more versatile fabrication techniques using niobium and niobium nitride was also begun, as was a simulation study aimed primarily at understanding spatially nonuniform long junction structures. GRA

N87-21696# Purdue Univ., West Lafayette, Ind. School of Electrical Engineering.

THE 2-4 SEMICONDUCTOR SUPERLATTICES Annual Technical Report, 1 Jul. 1985 - 30 Jun. 1986

Robert L. Gunshor, L. A. Kolodziejski, Supriyo Datta, and N. Otsuka 30 Nov. 1986 15 p

(Grant AF-AFOSR-0185-85)

(AD-A177092; AFOSR-87-0184TR) Avail: NTIS HC A02/MF A01 CSCL 20/12

This report recalls recent results concerning the growth (by molecular beam epitaxy) and evaluation of quantum well and superlattice structures in the (Zn, Mn)Se materials system. This wideband 2-4 semiconductor has potential applications for light emission in the blue/blue-green portion of the spectrum. GRA

N87-21697# Brookhaven National Lab., Upton, N. Y.

THE ACCEPTANCE OF THE SSC (SUPERCONDUCTING SUPERCOLLIDER) CLUSTERED LATTICE

G. F. Dell 1986 2 p Presented at the Summer Study on the Physics of the Superconducting Super Collider, Snowmass, Colo., 23 Jun. 1986

(Contract DE-AC02-76CH-00016)

(DE87-004177; BNL-39047; CONF-8606215-24) Avail: NTIS HC A02/MF A01

The physical apertures of all elements of the SSC storage lattices are considered to determine whether correction of random multipole fields in the triplet quadrupoles is necessary when betatron amplitudes there are no more than the inner radius of the beam pipe. During computer simulated beam tracking the influence of random multiple fields was included as a kick given to the test particle at the center of each quadrupole and at the ends of every dipole. The degree of multipole correction needed is shown. DOE

N87-21698# Brookhaven National Lab., Upton, N. Y.

DETERMINATION OF THE LINEAR APERTURE OF THE SSC (SUPERCONDUCTING SUPERCOLLIDER) CLUSTERED LATTICE USED FOR THE CONCEPTUAL DESIGN REPORT

G. F. Dell 23 Jun. 1986 7 p Presented at the Summer Study on the Physics of the Superconducting Super Collider, Snowmass, Colo., 23 Jun. 1986

(Contract DE-AC02-76CH-00016)

(DE87-004179; BNL-39045; CONF-8606215-25) Avail: NTIS HC A02/MF A01

A study is made of the linear aperture for the clustered lattice used for the SSC Conceptual Design Report. Random multipole errors are included in all magnetic elements including the insertion dipoles and quadrupoles. Based on the concept of smear, the linear aperture is equal to the dynamic aperture in the range -0.1 less than or equal to delta P/P less than or equal to 0.03%. Strong coupling for delta P/P $>$ 0% produces large smears. A variation of the smear parameter that is insensitive to coupling is proposed. A comparison is made with results reported in the SSC Conceptual Design Report. DOE

N87-21699# Brookhaven National Lab., Upton, N. Y.

BASIC IDEAS IN THE THEORY OF ORGANIC CONDUCTORS

V. J. Emery 1986 19 p Presented at the Low-Dimensional Conductors and Superconductors, Quebec, Canada, 24 Aug. 1986

(Contract DE-AC02-76CH-00016)

(DE87-003209; BNL-38924; CONF-8608146-1) Avail: NTIS HC A02/MF A01

From a theoretical point of view, the central goals are to understand how the organic superconductors managed to avoid a Peierls transition, and to unravel the fundamental mechanism of superconductivity, the source of the pairing interaction between charge carriers. The aim of these lectures is to address these questions in a general way, after giving an elementary survey of the basic physics of organic conductors. DOE

N87-21700# California Univ., Berkeley. Lawrence Berkeley Lab.

PERIOD THREE GENERATION ON MICROWAVE-INDUCED CONSTANT-VOLTAGE STEPS OF JOSEPHSON TUNNEL JUNCTIONS

J. Mygind, J. BindslevHansen, J. Clarke, G. A. Ovsyannikov, and H. Svensmark Oct. 1986 6 p Presented at the Applied Superconductivity Conference, Baltimore, Md., 28 Sep. 1986 Prepared in cooperation with Technical Univ. of Denmark, Lyngby

(Contract DE-AC03-76SF-00098)

(DE87-003530; LBL-22431; CONF-860914-28) Avail: NTIS HC A02/MF A01

We report the observation of one-third harmonic generation in small Josephson tunnel junctions driven with a microwave signal in the frequency range 8 to 18 GHz. This phenomenon was observed both with the junction biased in the zero voltage state and on microwave-induced constant-voltage steps in the current-voltage characteristic. With high levels of applied microwave power the period-tripled signal was detected on steps up to order 120. DOE

N87-21701# California Univ., Berkeley. Lawrence Berkeley Lab.

FIELD EFFECT AND JOSEPHSON JUNCTION

V. Z. Kresin Sep. 1986 7 p Presented at the Applied Superconductivity Conference (ASC '86), Baltimore, Md., 28 Sep. 1986

(Contract DE-AC03-76SF-00098)

(DE87-004473; LBL-22185; CONF-860914-29) Avail: NTIS HC A02/MF A01

The value of the Josephson current in an S-M-S system, where M contains low-dimensional electron gas, can be affected noticeably by an applied voltage (field effect). This effect is directly related to the possibility of building a three-terminal device. The dependence of the current on the carrier concentration is studied. The peculiar situation when the state of lowest subband is described by the dirty limit whereas the higher subband represent the clean limit appears to be realistic. Inter-subband scattering results in a non-monotonic behavior of the current. DOE

N87-21702# Brookhaven National Lab., Upton, N. Y.

EXAFS STUDIES OF GRAIN BOUNDARY DIFFUSION AND SEGREGATION

S. M. Heald, H. Chen, and J. M. Tranquada 1986 4 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986

(Contract DE-AC02-76CH-00016)

(DE87-003435; BNL-39073; CONF-861207-40) Avail: NTIS HC A02

The dominant pathway for thin film interdiffusion and interface reactions is often via grain boundaries. We have made EXAFS measurements of grain boundary constituents for two systems: interdiffusion in Ag-Au bilayers and solid state reaction of Nb with a copper-tin bronze to form Nb3Sn. The Ag-Au results indicate that Au in saturated Ag grain boundaries has an environment similar to a dilute Au in Ag solution with reduced coordination. For the Nb-bronze reaction, the results for the Cu environment indicate distinct changes in the grain boundary environment when small amounts of Ti, Hf, Zr, and Ta are added to the starting Nb. Both results demonstrate the ability of EXAFS to probe grain

boundary environments, and to provide important structural information in understanding solid state diffusion and interdiffusion in thin film systems. DOE

N87-21703# Sandia National Labs., Albuquerque, N. Mex.
STRESS RELEASE IN ION IMPLANTED LATTICE MISMATCHED SEMICONDUCTOR HETEROSTRUCTURES
G. W. Arnold, S. T. Picraux, D. R. Myers, B. L. Doyle, P. S. Peercy, R. M. Biefeld, and L. R. Dawson 1986 6 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986
(Contract DE-AC04-76DP-00789)
(DE87-004518; SAND-86-1821C; CONF-861207-41) Avail: NTIS HC A02/MF A01

Cantilever-beam measurements of ion-implantation induced stress in (InGa)As/GaAs, Ga(AsP)/GaP, and Ga(AsP)/GaAs strained layer superlattices (SLSs), grown either by molecular-beam epitaxy (MBE) or metalorganic chemical vapor deposition (MOCVD), have shown that a mechanism for precipitous stress-relief can be operative for room-temperature damage-energy deposition values above approx. 2 x 10 to the 20th power keV/cu cm. This phenomenon is correlated with the initial residual compressive stress on the composite structure and is determined by the differences in lattice parameter between the substrate and the buffer alloy-layer. DOE

N87-21704# Los Alamos National Lab., N. Mex.
GaAs PHOTOCONDUCTORS TO CHARACTERIZE PICOSECOND RESPONSE IN GaAs INTEGRATED DEVICES AND CIRCUITS
R. B. Hammond, N. G. Paulter, and A. J. Gibbs 1986 4 p Presented at the International Conference on High-speed Electronics, Stockholm, Sweden, 7 Aug. 1986
(Contract W-7405-eng-36)
(DE87-003744; LA-UR-86-4285; CONF-8608147-2) Avail: NTIS HC A02/MF A01

Optoelectronic techniques that use femtosecond lasers and promise the precise measurement of transient response in high speed electronic devices and circuits have been under study for several years. We have investigated on-wafer electrical-impulse generation and sampling using femto-second-laser-excited GaAs photoconductors. This approach is applicable to any transmission line structure, it is directly integrable, non-invasive, jitter-free, and it is applicable to both microwave and digital circuits. We have developed the capability to: (1) generate electrical impulses in on-wafer GaAs transmission lines with 3-dB bandwidths in excess of 60 GHz, and (2) sample the electrical impulse response of an on-wafer test structure without jitter and with a 3-dB measurement bandwidth of 103 GHz at a noise level of -67 dBm. We have studied dispersion in GaAs on-wafer coplanar-waveguide transmission lines. DOE

N87-21705# Los Alamos National Lab., N. Mex.
CHARACTERIZATION OF ON-CHIP POLYCRYSTALLINE SILICON PHOTOCONDUCTORS
D. K. Fitzpatrick (Harris Semiconductor, Melbourne, Fla.), D. R. Bowman (Military Academy, West Point, N. Y.), and R. B. Hammond 1986 5 p Presented at the International Conference on High-speed Electronics, Stockholm, Sweden, 7 Aug. 1986 Prepared in cooperation with Harris Semiconductor, Melbourne, Fl.; Military Academy, West Point, NY.
(Contract W-7405-eng-36)
(DE87-003745; LA-UR-86-4286; CONF-8608147) Avail: NTIS HC A02/MF A01

We report experimental and modeling studies of on-ship photoconductor pulse generation and sampling. Specifically, we discuss (1) the effect of ion-beam damage on carrier lifetime and sampling-aperture time, (2) the circuit limits to pulse risetime, and (3) the room-temperature stability of ion-beam-damaged sampling gates. DOE

N87-21706# Argonne National Lab., Ill.
NATURE OF COUPLING AND DIMENSIONAL CROSSOVER IN SUPERCONDUCTING MULTILAYERS
J. P. Locquet, W. Sevenhans, Y. Bruynseraede, H. Homma, and I. K. Schuller Sep. 1986 5 p Presented at the Applied Superconductivity Conference, Baltimore, Md., 28 Sep. 1986 Prepared in cooperation with Louvain Univ. (Belgium)
(Contract W-31109-eng-38)
(DE87-004676; CONF-860914-31) Avail: NTIS HC A02

A comparison of the temperature dependent upper critical fields in Josephson and proximity coupled multilayers is presented. The results are in good agreement with theoretical expectations which predict that the main determining factor is the spatial variation of the electronic density of states. DOE

N87-21707# Argonne National Lab., Ill.
COMPUTER SIMULATION OF SPECIAL GRAIN BOUNDARIES IN METALS AND IONIC MATERIALS
D. Wolf 1986 8 p Presented at the International Workshop on Condensed Matter Theories, Argonne, Ill., 21 Jul. 1986
(Contract W-31109-eng-38)
(DE87-004989; CONF-860789-4) Avail: NTIS HC A02/MF A01

In recent years a set of lattice statics computer codes has been developed which permits one to determine the energies, structures, and point-defect properties of grain boundaries in metals and predominantly ionic ceramic materials. In contrast to metals, long-range Coulomb forces between the ions have to be considered in ionic bicrystals. The selection criteria for the identification of special (i.e., low-energy) grain boundaries (GBs) is discussed with particular emphasis on: (1) the role of the GB plane, (2) the influence of the planar unit-cell area, and (3) the effect of the interatomic potential on the predicted energies and structures of GBs in metals and ionic materials. DOE

N87-21708# Argonne National Lab., Ill.
SUPERCONDUCTING PROPERTIES OF COMPOSITIONALLY MODULATED Pb/Ge THIN FILMS
J. P. Locquet, W. Sevenhans, Y. Bruynseraede, H. Homma, and I. K. Schuller Apr. 1986 4 p Presented at the Applied Superconductivity Conference (ASC '86), Baltimore, Md., 28 Sep. 1986 Prepared in cooperation with Louvain Univ., Belgium
(Contract W-31-109-eng-38)
(DE87-004679; CONF-860914-32) Avail: NTIS MF A01

Finely layered superconducting Pb/Ge multilayers have been made on liquid nitrogen cooled sapphire substrates with use of a mass spectrometer rate controlled electron beam evaporation scheme. Individual layer thicknesses range from 1 to 10 nm, each sample containing 50 to 100 Pb/Ge layer pairs with different Pb-to-Ge thickness ratio. An x-ray analysis showed that the samples have a superlattice structure consisting of amorphous Ge layers and (III) textured polycrystalline Pb layers. Transport studies reveal that the relationship between Tc and Pb-layers resistance is influenced by the layer thickness and the evaporation conditions. Measurements of the upper critical field versus temperature clearly show the dimensional crossover effects present in Josephson coupled two-dimensional superconductors. The maximum observed in the critical current versus field curve is related to the individual layer thickness. DOE

N87-21709# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
INVESTIGATIONS ON THE MBE GROWTH AND PROPERTIES OF Al/(y)/Ga/(y)/In/(1-x-y/As/InP) AND InAlAs SUPERLATTICES Progress Report, 15 May 1986 - 31 Jan. 1987
P. K. Bhattacharya and R. Gibala 1987 27 p
(Contract DE-FG02-86ER-45250)
(DE87-005190; DOE/ER-45250/1) Avail: NTIS HC A03/MF A01

Focus of the work has been to grow wide-bandgap ternary and quaternary semiconductors InAlAs and InGaAlAs by molecular beam epitaxy and to investigate their electronic, optical and structural characteristics. The techniques being used are x-ray, TEM, photoluminescence and absorption, DLTS, Hall transport, impact ionization and pulsed velocity field measurements. The experiments have included both lattice matched and strained layers. It is apparent that the lattice match In(sub 0.52)Al(sub 0.48)As. InP alloys are clustered and dominant D-X trap centers are present

in the strained compositions. We are investigating a novel MBE growth technique of growing these alloys directly on GaAs (with a 1 to 4% lattice mismatch) without propagating dislocations. These heteroepitaxial layers and interfaces are being studied by TEM.
DOE

N87-21710# Argonne National Lab., Ill.
GRAIN-BOUNDARY MODELING
D. Wolf Nov. 1986 45 p Presented at the American Society of Metals Materials Week, Lake Buena Vista, Fla., 6 Oct. 1986
(Contract W-31109-eng-38)
(DE87-004737; CONF-861063-4) Avail: NTIS HC A03/MF A01

A comprehensive set of computer codes has been developed in recent years enabling one to investigate the physical properties of grain boundaries in metals and predominately ionic ceramic materials. In this brief overview the modeling of grain boundaries in metals at absolute zero temperature by means of lattice-statics (iterative energy minimization methods) is described. In contrast to experiments in computer simulations, it is rather easy to systematically vary the five macroscopic geometrical parameters describing a planar, bicrystalline grain boundary. In this manner, computer modeling can be used to extract rather fundamental insight into the physics of solid interfaces. By comparing the results of such computer experiments with experimental results whenever possible, the validity range of these simulation methods can be tested. As reviewed in this paper, the combination of computer-simulation studies with related experiments is capable of providing insight which, from experiments alone, would be very difficult to obtain.
DOE

N87-21711# Sandia National Labs., Albuquerque, N. Mex.
MBE (MOLECULAR BEAM EPITAXY) GROWTH OF STRAINED-LAYER SUPERLATTICE DEVICE STRUCTURES
L. R. Dawson Feb. 1987 6 p Presented at the 4th International Workshop on Future Electron Devices, Tokyo, Japan, 9 Feb. 1987
(Contract DE-AC04-76DP-00789)
(DE87-005881; SAND-87-0182C; CONF-870256-1) Avail: NTIS HC A02

Strained-layer superlattices are periodic structures composed of mismatched layers whose thickness does not exceed the critical value for elastic deformation, thus avoiding the generation of misfit dislocations. For semiconductor applications this greatly increases the range of alloys available for high quality (nearly defect-free) materials and provides novel methods for tailoring many electronic and optical properties. Molecular Beam Epitaxy (MBE) growth techniques have been used for the growth of high quality InGaAs/GaAs and InAsSb/InSb structures.
DOE

N87-21712# Tennessee Univ., Knoxville.
THE EFFECT OF ION DAMAGE AND ANNEALING ON SUPER-CONDUCTING TRANSITION METAL-NITRIDE COMPOUNDS Ph.D. Thesis
J. T. Ellis Mar. 1987 216 p Prepared in cooperation with Oak Ridge Associated Universities, Inc., Tenn.
(Contract DE-AC05-76OR-00033)
(DE87-005988; DOE/OR-00033/T280) Avail: NTIS HC A10/MF A01

Thin films of the B1 phase superconducting compounds vanadium nitride and titanium nitride were formed by heating evaporated pure metal films in high purity nitrogen gas. Resistivity at room and low temperature, superconducting transition temperature T/sub C/, and upper critical field of these films were found to be similar to those in bulk samples. The films were then irradiated with nitrogen ions and the effect of lattice damage determined. The dependence on ion fluence of the residual resistivity and the transition temperature obeyed saturating exponential functions that could be derived from a simple defect production and annealing model. The renormalized electronic density of states N*(O) was calculated as a function of ion fluence, while the band density of states Nb(O) was calculated using the electron lifetime model. The electron-phonon coupling constant was determined from these densities of states and from the McMillan equation for T/sub C/. Results do not agree and spin fluctuations cannot be used to explain the discrepancy. It is argued that some mechanism, other than lifetime reduction of the band density of states, is responsible for the observed effects. This is in contrast to the high temperature A15 superconductors in which the electron lifetime model yields large reductions in Nb(O). It is thought that any other mechanism present in these materials would be overshadowed by this large reduction. Subsequent annealing studies indicate that the radiation damage effects are reversible. Annealing in vacuum at high temperatures results in loss of nitrogen and thus degradation of the properties of the material. It is argued that the bonding in TiN is almost three times stronger than in VN.
DOE

N87-21713# Sandia National Labs., Albuquerque, N. Mex.
KINETICS AND THERMODYNAMICS OF QUASICRYSTALS AS DETERMINED BY SURFACE MODIFICATION TECHNIQUES
J. A. Knapp and D. M. Follstaedt 1986 14 p Presented at the 4th Rapid Solidification Conference, Santa Barbara, Calif., 14 Dec. 1986
(Contract DE-AC04-76DP-00789)
(DE87-005538; SAND-86-2334C; CONF-861257-1) Avail: NTIS HC A02/MF A01

The formation rates and high-temperature thermodynamic properties of rapidly-quenched metastable phases are difficult to measure using conventional techniques; yet such measurements are needed for a complete understanding of the phases. By using ion beam mixing and rapid energy-beam heating to form and treat Al-Mn surface alloys, we have measured high temperature properties of the metastable icosahedral and decagonal phases. We review our methods here and present measurements of growth rate, nucleation time, melting temperatures, and relative free energies.
DOE

N87-21714# Arizona Univ., Tucson.
ARTIFICIALLY STRUCTURED SUPERCONDUCTORS Progress Report
C. M. Falco 14 Oct. 1986 24 p
(Contract DE-AC02-83ER-45025)
(DE87-004007; DOE/ER-45025/14) Avail: NTIS HC A02

We have been conducting an experimental study of the preparation and structure of artificial metallic multilayers, as well as the superconducting properties of weak links in these materials. The major objective of this research is to produce materials with higher structural perfection than that achieved to date. A large portion of our efforts for the past three years was devoted to growth and sample characterization. A second objective has been to investigate the usefulness of these materials for superconducting weak links.
DOE

N87-21715# National Bureau of Standards, Boulder, Colo. Electromagnetic Technology Div.
ELECTROMECHANICAL PROPERTIES OF SUPERCONDUCTORS FOR HIGH-ENERGY PHYSICS APPLICATIONS
J. W. Ekin, L. F. Goodrich, J. Moreland, E. S. Pittman, and A. F. Clark Dec. 1986 101 p
(Contract DE-AI05-85ER-40240)
(DE87-006048; DOE/ER-40240/1; NBSIR-86-3061) Avail: NTIS MF A01

This report covers the first year of a 33-month project to establish a systematic base of experimental data on electromechanical effects in superconducting wire and cables for high-energy-physics magnet applications. The research is focused in four general research areas: electromechanical relationships in NbTi, studies of NbTi strands extracted from cables, sausaging effects in NbTi, and studies of the NbTi energy gap.
DOE

N87-21716# Ecole Centrale de Lyon (France). Lab. d'Electronique et de Technologie de l'Informatique.
ANALYSIS OF THE FEASIBILITY OF SILICON ON INSULATOR SUBMICRON CMOS TECHNOLOGY Ph.D. Thesis [ETUDE DE LA FAISABILITE D'UNE FILIERE CMOS-MICRONIQUE SUR SILICIUM SUR ISOLANT]
Andre-Jacques Auberton-Herve 1986 172 p In FRENCH

(ECL-86-07; ETN-87-99414) Avail: NTIS HC A08/MF A01

Laser seeding and oxygen implantation methods were chosen to produce and study sub-micron silicon CMOS devices. The experimental results show a definite correlation between the velocity of crystal growth and the presence of crystal defects. Optimum seeding conditions are established. Techniques used to control the characteristics of the MOS devices are discussed. The feasibility of this technology is demonstrated, and the very large development potential is discussed. ESA

N87-21717# Ecole Centrale de Lyon (France). Lab. d'Electronique, Automatique et Mesures Electriques.

CONTRIBUTION TO UNDERSTANDING AND MODELING HOT CARRIER INJECTION PHENOMENA IN SUBMICRON MOS DEVICES Ph.D. Thesis [CONTRIBUTION A LA COMPREHENSION ET A LA MODELISATION DES PHENOMENES D'INJECTION DES PORTEURS CHAUDS DANS LES DISPOSITIFS MOS SUBMICRONIQUES]

Antoine Pavlin 1986 214 p In FRENCH

(ECL-86-12; ETN-87-99419) Avail: NTIS HC A10/MF A01

Models including nonuniform electric fields are studied and the influence of magnetic fields on silicon to silica carrier injection is experimentally determined in order to analyze the physical conditions for the injection of hot carriers into the silica insulation of submicron MOS structures. Existing models are rejected, showing that the distribution of hot carriers has a strong influence on the injected current. A simple analytical model is presented to describe the anisotropy of the carrier distribution, which is closer to a spherical distribution than to an orientation in the sense of the electric field. ESA

N87-21718# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.

TRANSPORT PROPERTIES OF GaAs. CONTRIBUTION TO THE STUDY OF GaAs/(Ca,Sr)F2 STRUCTURES USING MOLECULAR BEAM EPITAXY Ph.D. Thesis - Toulouse Univ., France

Jalal Nejjar 1986 156 p In FRENCH; ENGLISH summary

(LAAS-86-330; CNRS-Order-3373; ETN-87-99410) Avail: NTIS HC A08/MF A01

Hetero-epitaxial thin crystal layers deposited on insulator were investigated using molecular beam techniques. The resistivity and the Hall coefficient were measured using the Pauw technique. The evolution of the crystal growth and the doping constituants (Si and As) concentration were studied. Carrier mobilities as a function of concentration are compared with those obtained for homo-epitaxial techniques. A qualitative interpretation of the low carrier mobility found is offered. The generation of crystal defects at the beginning of the crystal growth degrades the characteristics, but the quality improves with thickness. ESA

N87-21719# Technische Hogeschool, Delft (Netherlands).

COMPUTER GENERATION OF CONVERGENT BEAM ELECTRON DIFFRACTION PATTERNS Ph.D. Thesis

Nico Selhorst Blom Jul. 1986 124 p Sponsored by the Nederlandse Organisatie voor Zuiver Wetenschappelijk

(ETN-87-99578) Avail: NTIS HC A06/MF A01

A computer program based on the N-beam dynamical theory of diffraction (Bethe 1928) for the simulation of convergent beam electron diffraction (CBED) patterns from single crystal and bicrystal specimens was written. The program was used to calculate CBED patterns for silicon, gallium-arsenide, and gold single crystal and bicrystal specimens, in order to assess the usefulness of the technique of CBED as an investigative tool for the study of grain boundary structures. Imaging parameters for using the techniques are given. ESA

N87-21720# Technische Hogeschool, Eindhoven (Netherlands).

ANALYSIS OF THE MAGNETIC PROPERTIES OF SEMIMAGNETIC SEMICONDUCTORS. AN EXPERIMENTAL STUDY Ph.D. Thesis Ph.D. Thesis

Cornelis Johannes Maria Denissen 1986 134 p

(ETN-87-99579) Avail: NTIS HC A07/MF A01

A spin-glass transition was observed in Zn1-xMnxse and Zn1-xMnxTe in a wide range of Mn concentrations x and, particularly, far below the percolation limit. It is shown that the concentration dependence of the freezing temperature Tf of these materials, as well as other II-VI wide-gap compounds like Cd1-xMnxTe and Cd1-xMnxSe, shows a remarkable universal behavior in the whole concentration range 0.01 to 0.6. If one exploits scaling-like arguments to relate Tf(x) to the distance (R) dependence of the Mn-Mn exchange interaction J(R), a simple powerlaw dependence J = R to the minus n with n = 6.8 appears to fit all the data, indicating a short-range of the interactions. A similar analysis was performed on data on other semimagnetic semiconductors and a variation of the interaction range is observed. This variation is tentatively attributed to either covalencey effects or a variation of the band gap. ESA

N87-21721# Rome Univ. (Italy). Dipt di Fisica.

A MICROSCOPIC THEORY FOR THE BRILLOUIN INTENSITIES EVALUATION IN NOBLE GAS CRYSTALS

V. Mazzacurati, G. Signorelli, and G. Ruocco (Aquila Univ., Italy) 11 Sep. 1986 15 p Submitted for publication

(Preprint-521; ETN-87-99736) Avail: NTIS HC A02/MF A01

A parameter free theory to calculate longitudinal and transverse Brillouin scattering intensities in cubic crystals was developed. The procedure, which is based on a correct treatment of the electromagnetic problem for a lattice of point polarizable atoms (pure DID effect), leads to results which are in better agreement than any other previous calculation with the measured values for the elasto-optic coefficient ratios P12/P11 and P44/P11 in the light rare gas crystals. A nonvanishing value for (P11 -P12 +3P44) is predicted without introducing short range overlap corrections. The good agreement suggests that overlap and exchange effects do not contribute significantly to the effective polarizability value in neon and argon crystals, at least within the accuracy of the experimentally available results. ESA

N87-21722# Rome Univ. (Italy). Dipt. di Fisica.

EVALUATION OF BRILLOUIN SCATTERING INTENSITIES FROM RARE GAS CRYSTALS. PART 1: A PURE DIPOLE INDUCED DIPOLE THEORY

V. Mazzacurati and G. Ruocco (Aquila Univ., Italy) 4 Dec. 1986 72 p Submitted for publication

(Preprint-535; ETN-87-99750) Avail: NTIS HC A04/MF A01

A pure dipole induced dipole (DID) theory, which takes properly into account long range contributions to the effective atomic polarizability renormalization, is developed to evaluate the Brillouin scattering intensities for rare gas crystals (RGC). The DID effect is taken into account at all the orders by solving rigorously the self consistent equation for the effective atomic polarizability. To evaluate the contribution of the far away atoms, the dipole propagator and the driving field phase factor were used without short range approximations. Results for the elasto-optic coefficient are discussed. It is concluded that pure DID effects can reproduce experimental results for neon and argon, while discrepancies progressively appear for krypton and xenon. This suggests that the overlap contributions to the atomic polarizability fluctuations cannot be neglected in heavy RGC. ESA

N87-21723# Bureau of Mines, University, Ala. Research Center.

MEASUREMENT OF DIELECTRIC PROPERTIES OF MINERALS AT MICROWAVE FREQUENCIES, REPORT OF INVESTIGATIONS 1986

W. E. Webb and R. H. Church 1986 15 p

(PB87-116968; BM-RI-9035; LC-86-600083) Avail: NTIS HC A02/MF A01 CSCL 20B

The report describes a method the Bureau of Mines devised for measuring the dielectric constant and loss tangent of low-loss minerals at microwave frequencies. Determination of these properties makes it possible to predict the effects of using microwave heating in potential mineral processing applications. The method uses a test cell and radio-frequency (RF) impedance analyzer with automated data acquisition and analysis. In the initial

phase of microwave heating research, the Bureau measured dielectric constants and loss tangents at frequencies between 100 MHz and 1 GHz. The objective was to establish reliable data for use in predicting the effects of microwave heating on minerals. Comparison with previously measured data showed the Bureau's measurement method to be accurate to within 3 pct. The report describes the method and discussed the preliminary results of the Bureau's investigations. Typical comparative data are included. GRA

N87-21724# National Bureau of Standards, Gaithersburg, Md. Reactor Radiation Div.
CRYSTAL DATA: VERSION 1.0 DATABASE SPECIFICATIONS Final Report
J. K. Stalick and A. D. Mighell Nov. 1986 75 p
(PB87-140414; NBS/TN-1229) Avail: NTIS HC A04/MF A01; also avaailable SOD HC $3.75 as 003-003-02781-2 CSCL 20B

The NBS Crystal Data database is a file of crystallographic and chemical data covering a broad spectrum of solid-state materials: inorganics, minerals, metals, intermetallics, organics, and organometallics. To be included in the database the unit-cell parameters of a material must be known. With the aid of computer programs, the data were evaluated by the Editors for reasonableness and self-consistency, and errors or possible errors are noted. The data items have been formated in a standard way to permit services. Each entry in the database contains unit-cell data (initial cell, convential Crystal Data cell, and reduced cell), space group or diffraction aspect, formula units per cell, observed and calculated densities, literature reference, chemical or mineral name, chemical formula, empirical formula, and an indication of the extent to which the atomic positional parameters have been determined. In addition to identification of unknowns by lattice-matching techniques, the large size of the database along with the combination of crystallographic, chemical and physical information make this file a valuable resource for all of solid-state science. GRA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N87-21725# Los Alamos National Lab., N. Mex.
THE GRAVITATIONAL PROPERTIES OF ANTIMATTER
T. Goldman, R. J. Hughes, and M. M. Nieto Sep. 1986 11 p Presented at the International School on Low Energy Antiproton Physics, Sicily, Italy, 27 Sep. 1986
(Contract W-7405-eng-36)
(DE87-003367; LA-UR-86-3882; CONF-8609221-1) Avail: NTIS HC A02/MF A01

It is argued that a determination of the gravitational acceleration of antimatter towards the earth is capable of imposing powerful constraints on modern quantum gravity theories. Theoretical reasons to expect non-Newtonian non-Einsteinian effects of gravitational strength and experimental suggestions of such effects are reviewed. DOE

N87-21726# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.
MULTIPLET CALCULUS AND COMPENSATING FIELDS IN D = 2 CONFORMAL SUPERGRAVITY
J. W. vanHolten Mar. 1986 31 p
(NIKHEF-H/86-11; B8673685; ETN-87-99595) Avail: NTIS HC A03/MF A01

The construction of conformal (1,1) and (1,0) supergravity is discussed. The representations of the local supersymmetry algebras on scalar, spinor, and vector multiplets are given, and a procedure for constructing invariant actions is established. Lagrange densities for these multiplets are constructed. A compensating multiplet of fields with nonlinear transformation law is found. It can be used to construct conformal actions for the (super) gravity fields, such as the dilaton term in string theories. It can also be used to pass to Poincare supergravity by classical fixing. It has a dual multiplet compensating for local Lorentz transformations. From this multiplet Poincare-like supergravity with local dilatation invariance, but broken d=2 Lorentz invariance can be constructed. ESA

N87-21727# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.
THE d=2 CONFORMAL GAUGE THEORY
J. W. vanHolten Jun. 1986 21 p
(NIKHEF-H/86-13; B8673003; ETN-87-99597) Avail: NTIS HC A02/MF A01

Conformal gravity in d=2 is constructed and discussed with a view to its application in string theory. The treatment of conformal invariance and the construction of a conformal gauge theory presented can be generalized to the case of the superconformal algebra. It is important in the context of the spinning string. ESA

N87-21728# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.
RESIDUAL SUPERSYMMETRY OF COMPACTIFIED d=10 SUPERGRAVITY
B. deWit, D. J. Smit, and N. D. HariDass May 1986 46 p
(NIKHEF-H/86-15; B8675730; ETN-87-99598) Avail: NTIS HC A03/MF A01

The conditions for residual supersymmetry in compactified ten-dimensional supergravity theories are investigated, including the effect of a nonconstant warp factor. The analysis is based on on-shell transformation laws which implies that certain linear combinations of classical field equations must be satisfied. The conditions for supersymmetry are, in general, not very restrictive. When, in addition, one assumes the validity of Bianchi identities, two independent contractions of the Einstein equation are implied. These equations exclude d=4 de Sitter space; for compactifications to d=4 Minkowski space they only allow purely metric Ricci-flat field configurations with constant warp factor. ESA

N87-21729# Rome Univ. (Italy). Dipt. di Fisica.
GAUGE FIXING FOR THE FIELD THEORY OF THE BASONIC STRING
Marco Bochicchio (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) 25 Sep. 1986 17 p Submitted for publication
(Preprint-527; ETN-87-99742) Avail: NTIS HC A02/MF A01

A procedure for the gauge fixing of the Witten theory of the bosonic string is given. The corresponding gauge-fixed action is invariant under a nilpotent BRST transformation. ESA

N87-21730# Rome Univ. (Italy). Dipt. di Fisica.
THEORETICAL SUMMARY
G. Altarelli 3 Nov. 1986 35 p Presented at the 6th International Conference on p pbar Physics, Aachen, West Germany, 30 Jun. - 4 Jul. 1986 Submitted for publication
(Preprint-532; ETN-87-99747) Avail: NTIS HC A03/MF A01

Particle collision experiments involving ppbar interaction are discussed. The physics of W/Z(0) bosons; results on sin sq theta W; missing E sub T; limits on new families; constraints on new gange bosons; B(0) B bar (0) mixing; and QCD are reviewed. ESA

N87-21731# Rome Univ. (Italy). Dipt. di Fisica.
HADRON PHENOMENOLOGY VIA THE FIRE-STRING MODEL
E. Ferrari 10 Nov. 1986 38 p Presented at the Course on Fundamental Interactions, Bogota, Colombia, 19-29 Aug. 1986 Submitted for publication Sponsored by the Italian Ministry of Education
(Preprint-533; ETN-87-99748) Avail: NTIS HC A03/MF A01

Anisotropic chromodynamics is introduced, and a derivative, the quark geometrodynamics or fire-string model is presented. Applications of the model to typical reactions involving hadronic final states, starting from the simplest and most interesting case (e(+) e(-) collisions), and then passing to more complicated

situations (deep inelastic scattering, hadron-hadron collisions) by increasing degree of complexity are illustrated. ESA

N87-21732# Rome Univ. (Italy). Dipt. di Fisica.
THE ABANDONED WAYS: TURBULENCE AND CHAOS [LE STRADE ABBANDONATE: LA TURBOLENZA E IL CAOS]
G. Battimelli and A. Vulpiani 23 Sep. 1986 35 p In ITALIAN
(Nota-Interna-869; ETN-87-99762) Avail: NTIS HC A03/MF A01

The philosophy of physics is discussed. The ideas included show a growing consciousness of the role of stochastic phenomena such as turbulence in modern science. ESA

N87-21733# Bureau of Mines, Albany, Oreg. Research Center.
HIGH-TEMPERATURE RELATIVE ENTHALPIES OF V205: REPORT OF INVESTIGATIONS/1986
M. J. Ferrante and R. V. Mrazek 1986 14 p
(PB87-140737; BM-RI-9039; LC-86-600208) Avail: NTIS HC A02/MF A01 CSCL 20M

Relative enthalpies of V2O5 from 298.15 to 1.101.0 K were measured at the Bureau of Mines to provide data needed for the advancement of mineral technology. Enthalpies were measured with a copper-block calorimeter. A sharp melting point was found at 951 K, with 15.690 kcal/mol for the standard enthalpy of melting. Tabulated values are given at selected temperature increments between 298.15 and 1,500 K for the standard relative enthalpy, heat capacity, entropy, and Gibbs energy function. Standard relative enthalpies are also given in equation form and combined with data from the literature to derive values of standard enthalpies of formation and Gibbs energies of formation. GRA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N87-21734# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
MANAGEMENT OF AUTOMATION PROJECTS THAT ARE RELEVANT FOR THE ROYAL DUTCH METEOROLOGICAL INSTITUTE (KNMI)
W. Loeve 23 Sep. 1985 21 p In DUTCH; ENGLISH summary
Presented at a conference, De Bilt, The Netherlands, Sep. 1985
(NLR-MP-85075-U; ETN-87-99293) Avail: NTIS HC A02/MF A01

Procedures required for policy making, management, and realization of automation projects that are relevant for a meteorological institute are described. Techniques that are used for the realization of information systems for the support of aircraft and spacecraft development can be applied. Information systems for technical-scientific applications are presented. The main problems involved in the management of automation projects are explained. The essential aspects of the management of creative talent, and the organizational and technical requirements for the development of information systems are discussed. ESA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N87-21735 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ONERA PUBLICATIONS CATALOG 1986
Oct. 1986 49 p In ENGLISH and FRENCH
(ETN-87-99379) Avail: NTIS HC A03

Over 1200 publications on aerodynamics, fluid mechanics, flight mechanics, propulsion, combustion, communication, navigation, instrumentation and equipment, measurement, structures, aeroelasticity, acoustics, optics, lasers, plasmas, the environment, mathematics and computer science, materials, solid state physics, and astronautics are listed. This is a list of all documents published by ONERA since it was created in 1946 and may be purchased there. There are two categories: Publications (P), and Technical Notes (NT). ESA

N87-21736* National Aeronautics and Space Administration, Washington, D.C.
UNIVERSITY PROGRAM MANAGEMENT INFORMATION SYSTEM, FISCAL YEAR 1986.
1986 390 p
(PB87-127379) Avail: NTIS HC $34.00 CSCL 05B

The University Program Report provides current information and related statistics for approximately 4300 grants/contracts/cooperative agreements active during the report period. NASA Field centers and certain Headquarters Program Offices provide funds for those R&D activities in universities which contribute to the mission needs of that particular NASA element. This annual report is one means of documenting the NASA-university relationship, frequently denoted, collectively, as NASA's University Program. Author

N87-21737# National Archives and Records Service, Washington, D. C. Archival Research and Evaluation Staff.
MARC (MACHINE READABLE CATALOG) FORMAT AND LIFE CYCLE TRACKING AT THE NATIONAL ARCHIVES: A STUDY Final Report
E. Hedlin and T. E. Weir May 1986 343 p
(PB87-126256; NARA/TIP-86/02) Avail: NTIS HC A15/MF A01 CSCL 05B

The National Archives conducted an 18 month study of life cycle tracking of records, the Machine Readable Catalog/Archival and Manuscript Control format (MARC/AMC), and the Research Libraries Information Network (RLIN). Life cycle tracking is the ability for the National Archives to capture and exchange information about Federal records from their creation to their destruction or use in an archives. It is proposed that the National Archives adopt the concept of life cycle tracking. This will require some changes in current procedures and the standardization of fields and vocabularies. The MARC/AMC is a data exchange format recently adopted by the Society of American Archivists for information interchange. The study found the format contained fields adequate for the description of Federal records. The format, however, does not support needed data structures. The Research Libraries Information Network is an information sharing service of the Research Libraries Group. RLN was found to be a medium for the exchange of information but was not found to be suitable as the primary automation tool for the National Archives and Record Administration. Author

N87-21738# Oak Ridge National Lab., Tenn. Information Resources Organization.
DOCUMENT PREPARATION GUIDE
Jul. 1986 367 p

(Contract DE-AC05-84OR-21400)
(DE86-015942; ORNL/IRO-1) Avail: NTIS HC A16/MF A01

A task force comprising representatives from all four installations (ORNL, ORGDP, Y-12, Paducah) has developed a single guide for preparation of documents. This guide, which assimilates and combines material from many style manuals and other sources, is representative of the continuing effort to reduce unnecessary duplication in administrative procedures. The purpose of the document preparation guide is to provide assistance to each person involved with dissemination of information. The guide is designed to specify regulations and responsibilities related to document preparation and to promote consistency within those documents. Federal, Department of Energy, Government Printing Office, Joint Committee on Printing, and Martin Marietta Energy Systems, Inc., regulations, directives, and procedures are outlined for every information product distributed, whether internal or external. The guide also provides a compilation of material necessary to ensure consistent format and styling to enhance the clarity of presentation. DOE

N87-21739# Oak Ridge Gaseous Diffusion Plant, Tenn.
USING BAR CODE TECHNOLOGY TO ENHANCE CLASSIFIED DOCUMENT ACCOUNTABILITY
P. J. Mountain and D. J. Wade 1986 28 p Presented at the 14th Annual Conference of the DOE/Contractors Micrographics and Information Management Association, Pleasanton, Calif., 4 Nov. 1986
(Contract DE-AC05-84OT-21400)
(DE87-000760; K/CSD/INF-86/19P; CONF-8611101-1) Avail: NTIS HC A03/MF A01

This paper describes a system of resources and procedures coordinated to improve a classified document inventorying process. The Bar Code Document Accountability System (BARDAS) was developed to demonstrate the feasibility of improving the management and reporting timeliness of secret document inventories by the accountable custodians. The paper discusses the reasons for the development method, the extensive error-checking, the degree of user-friendliness, and the use of bar code technology in accomplishing these goals. Finally, the reactions of users to the system and future plans for enhancement are discussed. DOE

N87-21740# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
USING VISION SYSTEMS WHEN BAR CODE WON'T WORK
D. R. Leader Jan. 1987 13 p Presented at the ID EXPO Meeting, Long Beach, Calif., 25 Mar. 1987
(Contract DE-AC09-76SR-00001)
(DE87-004514; DP-MS-86-137; CONF-870371-1) Avail: NTIS HC A02/MF A01

The Optical Character Reader Vision System is reviewed. Performance characteristics of this system are outlined and compared to bar code reading systems. DOE

N87-21741# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
FLEXIBLE AND DYNAMIC DATA MODEL APPLIED IN AN ENGINEERING DATA MANAGEMENT SYSTEM
H. A. Kreijkamp, F. J. Heerema, and H. J. vanHedel 1 Feb. 1985 25 p In DUTCH; ENGLISH summary Presented at the Congress on Design and Manufacturing using the Computer (CAPE 85 Netherlands), Amsterdam, The Netherlands, 1-3 May 1985
(NLR-MP-85011-U; ETN-87-99282) Avail: NTIS HC A02/MF A01

The requirements to be met by a data model applicable in a multidisciplinary engineering environment are discussed. It should be possible to structure the engineering data in different ways according to the needs of the different data base users. This structure of the data base should be reorganizable according to changing user requirements during the lifetime of the data base. As a case study the Engineering Data Interactive Presentation and Analysis System is described and illustrated with examples. ESA

N87-21742# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
APPLIED INFORMATICS IN PRACTICE
W. Loeve 18 Mar. 1985 21 p In DUTCH; ENGLISH summary (NLR-MP-85028-U; B8679803; ETN-87-99507) Avail: NTIS HC A02/MF A01

Technical and organizational aspects of the application of information systems for processing of technical data, process control, and digital simulation are treated. The purposes and tasks at institutes of applied scientific research are depicted. The organizational structures applied for the realization of these purposes are described. The tasks of computer scientists and their fitting into the organization are discussed. ESA

N87-21743# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
AUTOMATION STRATEGY FOR A ROYAL NETHERLANDS AIR FORCE (RNLAF) AIR BASE COMMAND AND CONTROL INFORMATION SYSTEM
W. N. vanDranen and R. P. deMoel 5 Sep. 1985 72 p In DUTCH; ENGLISH summary Presented at the Royal Institute of Engineers in the Netherlands, 's-Gravenhage, The Netherlands, 25 Sep. 1985
(NLR-MP-85070; ACIV/348/85; B8679801; ETN-87-99509) Avail: NTIS HC A04/MF A01

The automation of the supply of information for the RNLAF command and control, especially for the preparation of weapons systems, is treated. The two aspects of command, to give the command and to control its execution are discussed. It is shown how human intelligence and creativity combined with speed and storage capacity of the computer, can improve the quality of the preparation and the effectiveness of the deployment of weapons systems. ESA

N87-21744# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
EVALUATION OF THE OSI LD1200 OPTICAL DISKDRIVE
J. M. Burger 29 Aug. 1986 20 p
(NIKHEF-H/86-17; B8678513; ETN-87-99603) Avail: NTIS HC A02/MF A01

The laser-diskdrive of Optical Storage International, model LD1200 was tested to assess hardware and media reliability and to verify vendor supplied specifications. The OSI LD1200 is an easy to use and reliable storage device. The OSI media are reliable. It is possible to speed up the spindle rate which is now 480 rpm. The average seek time of 150 ms can be decreased by further optimizing the laser head movements. With respect to bad spots the specifications information is too pessimistic. Less than 0.1% of the available sectors are media bad spots which are acceptable. The specified transfer rate of 250 KB/s is misleading because the transfer rate is strongly dependent on the transferred blocksize. The seek times measured agree with those specified. Dust has little effect on data stability. ESA

N87-21745# Research Inst. of National Defence, Linkoeping (Sweden). Informations Systems Dept.
[ACTIVITIES REPORT OF THE INFORMATION SYSTEMS DEPARTMENT] Progress Report, 1985 - 1986
Kerstin Dolling, ed. Dec. 1986 57 p
(FOA-C-30441-3.3; ISSN-0347-3708; ETN-87-99775) Avail: NTIS HC A04/MF A01; Research Institute of National Defence, Stockholm, Sweden KR50

Research in computer vision, geographical information systems, and knowledge engineering is summarized. ESA

N87-21746# Oklahoma Univ., Norman. Science and Public Policy Program.
IMPROVING THE TRANSFER AND USE OF SCIENTIFIC AND TECHNICAL INFORMATION: THE FEDERAL ROLE. VOLUME 1: SUMMARY AND CONCLUSIONS Final Report
S. Ballard, C. R. McClure, T. I. Adams, M. D. Devine, and L. Ellison Sep. 1986 34 p Sponsored by the National Science Foundation

(PB87-142915) Avail: NTIS HC A03/MF A01 CSCL 05A

Investigated was the transfer and use of federally-supported scientific and technical information (STI) to improve the innovation capacity of private sector firms and their international economic competitiveness. Scientific and Technical Information is defined as the product of research and development. The project specifically addressed the products of federally-supported research and development for civilian purposes. While the potential for spin-offs from the defense R and D system is addressed briefly, a comprehensive review of the system is beyond the scope of the study. Three reports have been produced. Volume 1 summarizes key findings related to the information transfer and use process, identifies positive trends in technology development, and draws several conclusions related to the responsibilities of the Federal government and the private sector. GRA

N87-21747# Oklahoma Univ., Norman. Science and Public Policy Program.

IMPROVING THE TRANSFER AND USE OF SCIENTIFIC AND TECHNICAL INFORMATION: THE FEDERAL ROLE. VOLUME 2: PROBLEMS AND ISSUES IN THE TRANSFER AND USE OF STI Final Report

S. Ballard, C. R. McClure, T. I. Adams, M. D. Devine, and L. Ellison Nov. 1986 184 p Sponsored by the National Science Foundation

(PB87-142923) Avail: NTIS HC A09/MF A01 CSCL 05A

The project investigated the transfer and use of federally-supported scientific and technical information (STI) to improve the innovation capacity of private sector firms and their international economic competitiveness. Scientific and Technical Information is defined as the product of research and development. The project specifically addresses the products of federally-supported research and development for civilian purposes. While the potential for spin-offs from the defense R&D system is addressed briefly, a comprehensive review of the system is beyond the scope of the study. Three reports have been produced. Volume 2 identifies current programs, activities, and trends which determine the availability and value of R&D for the innovation process. Volume 2 also provides the supporting documentation for the conclusions presented here and in Volume 1 regarding the capacity of the U.S. to use its vast R&D resources for improving technological innovation. GRA

N87-21748# National Bureau of Standards, Gaithersburg, Md. Center for Electronics and Electrical Engineering.

TECHNICAL PUBLICATION ANNOUNCEMENTS COVERING CENTER PROGRAMS, JANUARY TO MARCH 1986

E. J. Walters Nov. 1986 24 p

(PB87-140273; NBSIR-86/3486) Avail: NTIS HC A02/MF A01 CSCL 05B

This is the eighth of a quarterly publication providing information on the technical work of the National Bureau of Standards Center of Electronics and Electrical Engineering. The issue of the Center for Electronics and Electrical Engineering Technical Publication Announcements covers the first quarter of calender year 1986. Abstracts are provided by technical area for papers published this quarter. GRA

N87-21749# National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.

HANDBOOK FOR OPERATION AND MAINTENANCE OF AN NBS (NATIONAL BUREAU OF STANDARDS) MULTISENSOR AUTOMATED EM (ELECTROMAGNETIC) FIELD MEASUREMENT SYSTEM

W. D. Bensema, G. H. Koepke, and H. W. Medley Oct. 1986 70 p

(PB87-140729; NBSIR-86/3056) Avail: NTIS HC A04/MF A01 CSCL 05B

A system is described that monitors and collects electromagnetic (EM) field strength information at five (optionally 10) locations simultaneously. The system has two modes of operation; (1) for sampling EM fields that are stationary for times of the order of 200 ms, and (2) for sampling changing EM fields with a system resolution of 10 microsec. Sensing elements for Mode 1 consist of three electrically short orthogonal dipoles mounted together, single dipole elements, or small loop antennas. Each element feeds a separate data input channel for a total of 15 (optionally 30) channels. Rf energy is converted to dc by a diode detector at each dipole. Mode 2 sensors will be diode detectors driven by broadband antennas. Real time system data processing includes calculation of field strength based on probe calibrations and processing of resultant data to satisfy measurement goals. GRA

N87-21750# National Bureau of Standards, Gaithersburg, Md.

MATERIALS INFORMATION FOR SCIENCE AND TECHNOLOGY (MIST): PROJECT OVERVIEW Final Report

W. Grattidge, J. Westbrook, J. McCarthy, C. Northrup, and J. Rumble Nov. 1986 132 p Prepared in cooperation with Sci-Tech Knowledge Systems, Inc., Scotia, N.Y., California Univ., Berkeley, Lawrence Berkeley Lab. and Sandia National Labs., Albuquerque, N. Mex.

(PB87-136677; NBS/SP-726; LC-86-600590) Avail: NTIS HC A07/MF A01; also available SOD HC $8.00 as 003-003-02780-4 CSCL 05B

The report documents the initial phases of the MIST database, which is a demonstration project jointly supported by the Department of Energy and the National Bureau of Standards. The purpose of the Materials Information for Science and Technology (MIST) is to demonstrate the power and utility of computer access to materials property data. The initial goals include: to exercise the concept of a computer network of materials databases and to build a demonstration of such a system in a way as to be suitable for use as the core of operational systems in the future. Phases 1 and 2 are described in detail. In addition, a discussion is given of the expected usage of the databases. GRA

N87-21751# National Bureau of Standards, Gaithersburg, Md. Information Resources and Services Div.

PUBLICATIONS OF THE NATIONAL BUREAU OF STANDARDS, 1985 CATALOG Rept., Jan. - Dec. 1985

R. J. Pardee Jun. 1986 394 p

(PB87-145272; NBS/SP-305-SUPPL-17; LC-48-47112) Avail: NTIS HC A17/MF A01; also available SOD HC $18.00 as 003-003-02737-5 CSCL 05B

The 17th Supplement to Special Publication 305 contains full bibliographic citations including keywords and abstracts for National Bureau of Standards (NBS) 1985 papers published and entered into the National Technical Information Service (NTS) collection. (Also included are NBS papers published prior to 1985 but not reported in previous supplements of this annual catalog.) Four indexes are included to allow the user to identify NBS papers by personal author, keywords, title, and NTIS order/report number. GRA

N87-21752# Tantalus, Inc., Cleveland Heights, Ohio.

APPLICATION OF THE MAXIMUM ENTROPY PRINCIPLE TO RETRIEVAL FROM VERY LARGE DATABASES

P. B. Kantor and J. J. Lee Jul. 1986 87 p

(Grant NSF IST-83-18360)

(PB87-115523; TANTALUS/GT-86/1; NSF/ENG-86008) Avail: NTIS HC A05/MF A01 CSCL 05B

A study of the implications of the maximum entropy principle for retrieval from very large data bases, with associated investigations of the problems of combining expert judgements for retrieval and other problems is presented. The project has established algorithms for selecting the combinations of characteristics most likely to yield useful retrieved items. Programs in FORTRAN run on an IBM PC/XT compatible computer with run times of less than 7 seconds for up to 4 terms. Computation time increases by a factor slightly less than three with each added term. The computation can be cast in perallel form to control the growth. GRA

N87-21189# Naval Air Propulsion Test Center, Trenton, N.J.

HIGH RESPONSE DATA ACQUISITION SYSTEM

Mark K. Fall and Henry P. Dress *In* AGARD Advanced Instrumenta-

tion for Aero Engine Components Nov. 1986 11 p (For primary document see N87-21170 14-31)
Avail: NTIS HC A24/MF A01

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N87-21753# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
PRESENT AND FUTURE MILITARY USES OF OUTER SPACE: INTERNATIONAL LAW, POLITICS, AND THE PRACTICE OF STATES M.S. Thesis
Donald E. Walsh Aug. 1986 211 p
(AD-A176722; AFIT/CI/NR-87-19T) Avail: NTIS HC A10/MF A01 CSCL 15/3

This thesis examines the present and future military uses of outer space with an emphasis on the policies and practices of international states. These policies and practices are examined in the context of the emergence of international space law. The thesis proceeds from an examination of the early years of the space age and move to an examination of the present and future military uses of outer space. Next is given a review of international treaties affecting military activities in outer space. The law is then applied to the present and future activities examined above, with prospects for the future. GRA

N87-21754# Office of Technology Assessment, Washington, D.C.
SPACE STATIONS AND THE LAW: SELECTED LEGAL ISSUES
Sep. 1986 88 p
(PB87-118220; OTA-BP-ISC-41; LC-86-600569) Avail: NTIS HC A05/MF A01 CSCL 05D

Part 1 is a background paper which discusses the legal consequences of developing and operating the space station. This paper examines the different ways in which a multinational space station might be owned and operated and explains how each could affect the rights and responsibilities of the U.S. Government and its citizens. In addition, it gives special attention to the application of jurisdiction, tort law, intellectual property, and criminal law to nations and individuals living and working in space. Part 2 of this report is a summary of the workshop held by OTA to critique and expand on the initial drafts of Part 1. GRA

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N87-21755* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
PERSONNEL EMERGENCY CARRIER VEHICLE Patent
Lester J. Owens, inventor (to NASA) (Planning Research Corp., Kennedy Space Center, Fla.) and Otto H. Fedor, inventor (to NASA) Issued 3 Mar. 1987 8 p Filed 3 Jul. 1985 Supersedes N86-22452 (24 - 12, p 2051)
(NASA-Case-KSC-11282-1; US-Patent-4,646,860; US-Patent-Appl-SN-751644; US-Patent-Class-180-19.2; US-Patent-Class-5-81-R; US-Patent-Class-60-415; US-Patent-Class-180-305; US-Patent-Class-280-47.11; US-Patent-Class-296-20) Avail: US Patent and Trademark Office CSCL 13F

A personnel emergency carrier vehicle is disclosed which includes a vehicle frame supported on steerable front wheels and driven rear wheels. A supply of breathing air is connected to quick connect face mask coupling and umbilical cord couplings for supplying breathing air to an injured worker or attendant either with or without a self-contained atmospheric protection suit for protection against hazardous gases at an accident site. A non-sparking hydraulic motion is utilized to drive the vehicle and suitable direction and throttling controls are provided for controlling the delivery of a hydraulic driving fluid from a pressurized hydraulic fluid accumulator. A steering axis is steerable through a handle to steer the front wheels through a linkage assembly.
Official Gazette of the U.S. Patent and Trademark Office

N87-21756*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A 1987 OVERVIEW OF FREE-PISTON STIRLING TECHNOLOGY FOR SPACE POWER APPLICATION
Jack G. Slaby and Donald L. Alger 1987 13 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89832; E-3485; NAS 1.15:89832) Avail: NTIS HC A02/MF A01 CSCL 10B

An overview is presented of the NASA Lewis Research Center free-piston Stirling engine activities directed toward space-power application. NASA Lewis serves as the project office to manage the newly initiated NASA SP-100 Advanced Technology Program. One of the major elements of this five-year program is the development of advanced power conversion concepts of which the Stirling cycle is a viable growth candidate. Under this program the status of the 25 kWe opposed-piston Space Power Demonstrator Engine (SPDE) is presented. Included in the SPDE discussion are comparisons between predicted and experimental engine performance, enhanced performance resulting from regenerator modification, increased operating stroke brought about by isolating the gas bearing flow between the displacer and power piston, identifying excessive energy losses and recommending corrective action, and a better understanding of linear alternator design and operation. Technology work is also conducted on heat exchanger concepts, both design and fabrication. Design parameters and conceptual design features are also presented for a 25 kWe, single-cylinder free-piston Stirling space-power converter. Author

N87-21757# Lawrence Livermore National Lab., Calif.
ADVANCED SENSORS, TELECOMMUNICATIONS AND DATA PROCESSING: TECHNOLOGICAL SPIN-OFFS FROM THE STRATEGIC DEFENSE INITIATIVE
L. L. Wood Oct. 1986 18 p Presented at the Strategic Defense Commercial Applications and Political-economic Implications Conference, Kiel, West Germany, 17 Oct. 1986
(Contract W-7405-eng-48)
(DE87-003884; UCRL-95532; CONF-8610212-1) Avail: NTIS HC A02/MF A01

While the details of Nitze Criteria-satisfying architectures for defense against strategic attack with ballistic missiles are still being worked out, it is already clear that quite advanced sensors, telecommunications and data processing technologies will be features of all of them. It is concluded that the SDI, due to its institutional youthfulness, its charter for large-scale research and its self-evident need for such technologies, is likely to dominate many aspects of these technology development areas during the next two decades, especially if it continues more-or-less as the

current American Administration contemplates. Both the technical and the economic aspects of data-gathering and manipulation seem likely to be substantially enhanced, due to the existence of the SDI. DOE

88 SPACE SCIENCES (GENERAL)

N87-21758# Naval Research Lab., Washington, D. C.
THE LOW FREQUENCY SPACE ARRAY Interim Report
B. K. Dennison, K. W. Weiler, K. J. Johnston, R. S. Simon, and J. H. Spencer 26 Dec. 1986 34 p
(AD-A177115; NRL-MR-5905) Avail: NTIS HC A03/MF A01 CSCL 03/1

A scientific justification and technical description is developed for the construction of a Low Frequency Space Array (LFSA) to carry out full sky mapping and individual source imaging at frequencies between 1.5 and 26.3 MHz; a frequency range over which the Earth's ionosphere transmits poorly or not at all. Such an instrument, with high resolution and high sensitivity, will open a new window in the electromagnetic spectrum to astronomical investigations. It will also bring astronomy to the fundamental limit below which observations from within the Milky Way become impossible due to absorption by the diffuse ionized hydrogen component of the interstellar medium. Many high quality scientific programs can already be specified for such an instrument and, due to the fact that it will be operating in essentially unexplored ranges of frequency, sensitivity and resolution, the likelihood of discovering entirely unexpected objects and processes is large. Also, even though the technology for constructing the elements of the LSFA already exists, its operation as an entirely space based synthesis interferometer will represent a significant advance in space capability. GRA

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N87-21759 California Univ., Berkeley.
ASTRONOMICAL OBSERVATIONS OF THE 807 GHz CO J = 7.6 ROTATIONAL LINE WITH A NEW HETERODYNE SPECTROMETER
Andrew Irwin Harris 1986 131 p
Avail: Univ. Microfilms Order No. DA8624779

The submillimeter transitions of carbon monoxide (CO) are a valuable tool for the study of warm (50 to 500 K) molecular material in the interstellar medium. The first detection and mapping of CO J = 7 yeilds 6 line emission in the central 10 pc of the Galaxy are presented. The CO data confirm that the neutral ring rotates about the center with a rotation axis close to that of general galactic rotation. The submillimeter CO data also suggest that the velocity centroids along the galactic plane drop by a factor of 1.4 to 2 between 2 and 6 pc from the center. The CO J = 7 yields 6 spectra were obtained with a submillimeter heterodyne receiver. Dissert. Abstr.

N87-21760 Columbia Univ., New York.
A CO SURVEY OF THE DARK NEBULAE IN TAURUS AND PERSEUS Ph.D. Thesis
Gregory Paul Baran 1986 198 p
Avail: Univ. Microfilms Order No. DA8623480

The large scale survey of carbon monoxide emission from the dark nebulae in Taurus and Perseus is examined. The CO spectra at 4395 points were obtained within an area of about 800 square degrees generally west of the galactic anti-center. The spatial resolution of the instrument was 8 arcminutes and the velocity was 2.6 km/s. The CO emission is strongest wherever extinction by dust is the greatest, spilling over the apparent outer boundaries of the dust clouds observed optically. Combining CO velocity for the nebulae with optically determined disturbances shows that the clouds in the survey area form several layers. The molecular cloud mass closest to the Sun in the Taurus and Auriga complex. Cloud masses were determined from integrated CO emission intensity alone by assuming that gamma-ray emission intensities can be used to relate H2 column densities to CO emission intensities. From CO emission alone, then, the cloud masses for the major complexes are presented. Dissert. Abstr.

N87-21761 California Univ., San Diego.
THE HARD X-RAY TO LOW ENERGY GAMMA-RAY SPECTRUM OF THE CRAB NEBULA Ph.D. Thesis
Gregory Victor Jung 1986 148 p
Avail: Univ. Microfilms Order No. DA8622871

The spectrum of the Crab Nebula was determined in the energy range 10 keV to 5 MeV from the data of the UCSD/MIT Hard X-ray and Low Energy Gamma-Ray Experiment on the first High Energy Astronomy Observatory (HEAO-1). The X-ray to gamma-ray portion of the continuous emission from the Crab is indicative of the electron spectrum, its transport through the nebula, and the physical conditions near the shocked interface between the nebular region and the wind which is the physical link between the nebula and the pulsar NP0532. The observations provide a crucial connection between the X-ray and gamma-ray spectrum of the nonpulsed emission of the Crab Nebula. The continuity of this spectrum suggests that the emission mechanism responsible for the nonpulsed gamma-rays observed above 35 MeV is of the same origin as the emission at lower energies. Interpretation of the spectral shape connecting the low energy X-ray and the gamma-ray spectra is independent of whether the transport process is primarily convective or diffusive. The cause of the spectral break can be related to several hypotheses, some of the less-contrived ranging from energy loss during the production of the high energy electron population to the development of pitch-angle anisotrophy in the nebular magnetic field.
Dissert. Abstr.

N87-21762# State Univ. of New York, Stony Brook.
ULTRAVIOLET OBSERVATIONS OF JUPITER AND URANUS Ph.D. Thesis
Richard Wagener 1986 125 p
Avail: Univ. Microfilms Order No. DA8623897

To further our understanding of the processes that led to the formation of organic molecules in the atmosphere of the primitive Earth, two of the planets that have maintained their reducing atmospheres were studied. The observations consist of spectra obtained with the International Ultraviolet Explorer (IUE) in the wavelength region from 1400 to 3350 angstons. After examining IUE spectra of Saturn's Rings, Mars, and the solar analogs 16 Cyg A and B, angstons found the rocket measurements of the full disk solar spectrum (Mount and Rottman, 1981; 1983a) to be the preferable solar calibration for calculating planetary reflectivities. A vertically inhomogeneous radiative transfer program was used to compute reflectivities of various model stratospheric compositions for comparison with the planetary spectra. The analysis of the equatorial region of Jupiter resulted in the detection of allene (C3H4) and another absorber near 1600 angstons, possibly cyclopropane (C3H6) or a high altitude haze. Small aperture observations of the Great Red Spot (GRS) and the South Tropical Zone (STrZ) in the 1900 to 2200 angstons wavelength region show that the enhancement of vertical mixing in the GRS due to upwelling is small and is not capable of significantly enhancing the PH3 abundance in the GRS. Thus, the photolysis of PH3 cannot be invoked to explain the red coloration of the GRS. Alternatives, such as nitrogen bearing compounds, should continue to be considered. Dissert. Abstr.

N87-21763*# Hawaii Univ., Honolulu. Inst. for Astronomy.
RESEARCH IN PLANETARY STUDIES AND OPERATION OF THE MAUNA KEA OBSERVATORY Semiannual Progress Report, Jan. - Dec. 1986
Dale P. Cruikshank Dec. 1986 92 p

(Grant NGL12-001-57)
(NASA-CR-180513; NAS 1.26:180513; SAPR-32; SAPR-33) Avail: NTIS HC A05/MF A01 CSCL 03A

The research programs are highlighted in the following areas: major planets; planetary satellites and rings; asteroids; comets; dark organic matter; theoretical and analytical structures; extrasolar planetary; and telescopes. B.G.

N87-21764*# Houseline, Inc., Swarthmore, Pa.
A NEW METHODOLOGY OF DETERMINING DIRECTIONAL ALBEDO MODELS FROM NIMBUS 7 ERB SCANNING RADIOMETER MEASUREMENTS Final Report
Frederick B. House Aug. 1986 52 p
(NASA Order S-30544-D)
(NASA-CR-177908; NAS 1.26:177908) Avail: NTIS HC A04/MF A01 CSCL 03A

The Nimbus 7 Earth Radiation Budget (ERB) data set is reviewed to examine its strong and weak points. In view of the timing of this report relative to the processing schedule of Nimbus 7 ERB observations, emphasis is placed on the methodology of interpreting the scanning radiometer data to develop directional albedo models. These findings enhance the value of the Nimbus 7 ERB data set and can be applied to the interpretation of both the scanning and nonscanning radiometric observations. B.G.

N87-21765# Los Alamos National Lab., N. Mex.
USING NONRADIAL PULSATIONS TO DETERMINE THE ENVELOPE COMPOSITION OF VERY EVOLVED STARS
Sumner Starrfield Jul. 1986 8 p Presented at the 2nd IAP Recontre on Nuclear Astrophysics, Paris, France, 7 Jul. 1986 Prepared in cooperation with Joint Inst. for Lab. Astrophysics, Boulder, Colo.
(Contract W-7405-eng-36)
(DE87-001982; LA-UR-86-3684; CONF-860793-4) Avail: NTIS HC A02/MF A01

Recent observational and theoretical studies of the ZZ Ceti variables (DA degenerate dwarfs), the DBV variables (DB degenerate dwarfs), and the GW Vir variables (DO degenerate dwarfs) have shown them to be pulsating in nonradial g (+)-modes. The pulsation mechanism has been identified for each class of variable star and, in all cases, involves predictions of the stars envelope composition. The ZZ Ceti variables must have pure hydrogen surface layers, the DBV stars must have pure helium surface layers, and the GW Vir stars must have carbon and oxygen rich surface layers. DOE

N87-21766# European Space Agency, Paris (France).
AD ASTRA HIPPARCOS. ASTRONOMICAL MISSION OF THE EUROPEAN SPACE AGENCY [AD ASTRA HIPPARCOS. MISSION ASTROMETRIQUE DE L'AGENCE SPATIALE EUROPEENE]
T. D. Guyenne, ed. Oct. 1986 50 p In FRENCH Translation was anounced as N86-18282 Original document contains color illustrations
(ESA-BR-24; ISSN-0250-1589; ETN-87-99431) Avail: NTIS HC A03/MF A01

Details of the HIPPARCOS project are given including goals, astrometry definitions, mission and satellite descriptions, onboard primary and secondary instruments, and time table. ESA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics*.

N87-21767 Princeton Univ., N. J.
DYNAMICAL EVOLUTION OF SPHERICAL STELLAR SYSTEMS Ph.D. Thesis
Hyung Mok Lee 1986 168 p
Avail: Univ. Microfilms Order No. DA8627938

The dynamical effect of heavy mass stars formed out of successive mergers among tidally captured binaries on evolution of spherical stellar systems is investigation. To maximize such an effect, it was assumed all tidally captured systems became mergers. Stellar evolution is simulated by computing mean age of mass group and applying death rate as a function of mean age. The effect of primordial degenerate stars is investigated. Observed number of low mass X-ray sources in globular clusters is consistent with tidally captured binaries between degenerate and normal stars in the model. Dissert. Abstr.

N87-21768 Texas Univ., Austin.
COLLISIONAL EVOLUTION IN THE ASTEROID BELT: AN OBSERVATIONAL AND NUMERICAL STUDY Ph.D. Thesis
Richard Peter Binzel 1986 314 p
Avail: Univ. Microfilms Order No. DA8618422

A major observational survey was conducted to investigate asteroid collisional evolution processes. Photoelectric observations of more than 100 small asteroids were obtained at the University of Texas McDonald Observatory and Cerro Tololo Inter-American Observatory on 150 nights between November, 1982 and February, 1985. These lightcurve data were used to determine shapes and rotational angular momenta of asteroids in six distinct dynamical regions: near the 3:1 resonance Kirkwood gap, Eos family members, Koronis family members, and three control groups. The survey data were analyzed to shed light on two major outstanding problems in solar system astrophysics: the collisional formation of the Kirkwood gaps and the collisional evolution of the Eos and Koronis families. It is concluded that inter-asteroid collisions are not an important process in clearing the Kirkwood gaps. The survey data show that Koronis and Eos families have distinctly different rotational properties from non-family asteroids and each other. A numerical model for asteroid collisions was developed to investigate the time evolution of rotational angular momentum. The modeling results imply that the Eos family is significantly more collisionally evolved than the Koronis family and is therefore probably older. Dissert. Abstr.

N87-21769 California Univ., Berkeley.
LASER MICROPROBE STUDIES OF RARE GAS ISOTOPES IN METEORITES Ph.D. Thesis
Charles Louis Kirschbaum 1986 113 p
Avail: Univ. Microfilms Order No. DA8624817

A rare gas mass spectrometer of high sensitivity coupled to a laser microprobe extraction system is described. The laser microprobe is applied to a long standing problem in cosmochemistry, determining the minerals which carry Xe-129 from the decay of the extinct radioactive isotope I-129 (this Xe-129 is referred to as Xe-129 sub r). The Xe-129 sub r/I-127 ratios and the inferred relative formation times of these materials are also determined. In the Allende meteorite, sodalite was verified to be the major carrier for Xe-129, in fine-grained inclusions. The Xe-129 sub r/I-127 ratios for sodalite from the fine-grained inclusions, and matrix are similar. This implies an age for these samples within 2 million years of the Bjurbole meteorites. The relative formation intervals are much longer than expected for nebular processes and hence are either due to parent body processes or heterogeneity of the I-129/I-127 ratio in the early solar system. Dissert. Abstr.

N87-21770# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
PICK-UP ION TRAJECTORIES IN A COMET MODEL M.S. Thesis
Charles D. Kimmel 1986 88 p
(AD-A176618; AFIT/CI/NR-87-18T) Avail: NTIS HC A05/MF A01 CSCL 03/2

In-situ measurements at Comets Giacobini Zinner and Halley reveal the presence of energetic cometary ions accelerated to energies at times over 100 keV. This study investigates how the underlying large scale magnetic field and velocity structure of an idealized comet, as represented by an MHD simulation, leads to the acceleration of these particles. Single particle trajectories have been computed using the results from Fedder and coworkers MHD simulation of comets for the background magnetic and convection electric fields. For the present numerical model, it is assumed

that the particles are not scattered by fluctuations in the field and plasma. In this scatter free limit, the trajectories of initially cold cometary ions which accelerated due to the large scale convection electric field are more widely dispersed in the plane of the interplanetary magnetic field than in the orthogonal plane. Ions created closets to the nucleus focus into the tail current sheet, while those ions created in the outer coma diverge from the tail axis in response to gradient and curvature drifts. Those ions initially formed close to the nucleus have a lower energy, forming the cold plasma sheet, while the ions created in the outer coma have greater energy and populate the hot wings that extend far from the tail axis. GRA

N87-21771# Lawrence Livermore National Lab., Calif.
RELATIVISTIC (3+1) DIMENSIONAL HYDRODYNAMIC SIMULATIONS OF COMPACT INTERACTING BINARY SYSTEMS
G. J. Mathews, C. R. Evans, and J. R. Wilson Sep. 1986 10 p Presented at the 2nd IAP Recontre on Nuclear Astrophysics, Paris, France, 7 Jul. 1986
(Contract W-7405-eng-48)
(DE87-000602; UCRL-95416; CONF-860793-1) Avail: NTIS HC A02/MF A01

We discuss the development of a relativistic hydrodynamic code for describing the evolution of astrophysical systems in three spatial dimensions. The application of this code to several test problems is presented. Preliminary results from the simulation of the dynamics of accreting binary white dwarf and neutron star systems are discussed. DOE

N87-21772# Los Alamos National Lab., N. Mex.
THEORETICAL AND OBSERVATIONAL REVIEW OF RESULTS ON NOVA EXPLOSIONS OCCURRING ON ONeMg WHITE DWARFS
S. Starrfield Jul. 1986 13 p Presented at the 2nd IAP Recontre on Nuclear Astrophysics, Paris, France, 7 Jul. 1986 Prepared in cooperation with Joint Inst. for Lab. Astrophysics, Boulder, Colo.
(Contract W-7405-eng-36)
(DE87-001962; LA-UR-86-3512; CONF-860793-2) Avail: NTIS HC A02/MF A01

The nova outburst is the second most violent explosion that occurs in a galaxy. This review presents the recent observational and theoretical studies that have demonstrated that there exist two classes of nova outburst. One type of nova occurs on a CO white dwarf and the other type of nova occurs on an ONeMg white dwarf. The second class of outbursts are much more violent and occur much more frequently than the first. Hydrodynamic simulations of both kinds of outbursts are in excellent agreement with the observations. DOE

N87-21773# Brookhaven National Lab., Upton, N. Y.
WHITE DWARF MODELS OF SUPERNOVAE AND CATACLYSMIC VARIABLES
K. Nomoto and M. Hashimoto 1986 10 p Presented at the International Astronomical Union Colloquium, Bamberg, West Germany, 16 Jun. 1986
(Contract DE-AC02-76CH-00016)
(DE87-004172; BNL-38863; CONF-8606204-2) Avail: NTIS HC A02

If the accreting white dwarf increases its mass to the Chandrasekhar mass, it will either explode as a Type I supernova or collapse to form a neutron star. In fact, there is a good agreement between the exploding white dwarf model for Type I supernovae and observations. We describe various types of evolution of accreting white dwarfs as a function of binary parameters (i.e., composition, mass, and age of the white dwarf, its companion star, and mass accretion rate), and discuss the conditions for the precursors of exploding or collapsing white dwarfs, and their relevance to cataclysmic variables. Particular attention is given to helium star cataclysmics which might be the precursors of some Type I supernovae or ultrashort period X-ray binaries. Finally we present new evolutionary calculations using the updated nuclear reaction rates for the formation of O+Ne+Mg white dwarfs, and discuss the composition structure and their relevance to the model for neon novae. DOE

N87-21774# Los Alamos National Lab., N. Mex.
PULSATIONS OF WHITE DWARF STARS WITH THICK HYDROGEN OR HELIUM SURFACE LAYERS
A. N. Cox, S. G. Starrfield, R. B. Kidman, and W. D. Pesnell Jul. 1986 6 p Presented at the IUA Symposium No. 123, Aarhus, Denmark, 7 Jul. 1986
(Contract W-7405-eng-36)
(DE87-001954; LA-UR-86-3395; CONF-8607108-1) Avail: NTIS HC A02/MF A01

In order to see if there could be agreement between results of stellar evolution theory and those of nonradial pulsation theory, calculations of white dwarf models have been made for hydrogen surface masses of 10 to the -4 solar masses. Earlier results indicated that surface masses greater than 10 to the -8 solar masses would not allow nonradial pulsations, even though all the driving and damping is in surface layers only 10 to the -12 of the mass thick. It is shown that the surface mass of hydrogen in the pulsating white dwarfs (ZZ Ceti variables) can be any value as long as it is thick enough to contain the surface convection zone. DOE

N87-21775# Los Alamos National Lab., N. Mex.
THE COMET GIACOBINI-ZINNER MAGNETOTAIL: AXIAL STRESSES AND INFERRED NEAR-NUCLEUS PROPERTIES
D. J. McComas, J. T. Gosling, S. J. Bame, J. A. Slavin, E. J. Smith, and J. L. Steinberg Oct. 1986 5 p Presented at the 20th ESLAB Symposium, Heidelberg, West Germany, 27 Oct. 1986 Prepared in cooperation with JPL, Pasadena, Calif. and Observatoire de Paris, France
(Contract W-7405-eng-36)
(DE87-003712; LA-UR-86-3942; CONF-8610207-4) Avail: NTIS HC A02/MF A01

Utilizing the electron and magnetic field data from the ICE tail traversal of Comet Giacobini-Zinner along with the MHD equations, we have developed a steady state, stress balance model of the cometary magnetotail. With it we infer many important but unmeasured ion properties within the G-Z magnetotail both at ICE and upstream at the average point along each streamline where cometary ions are picked up. The derived tailward ion flow speed at ICE is quite constant at approx. -20 to -30 km/sec across the entire tail. The flow velocity, ion temperature, density, and ion source rates upstream from the lobes (current sheet) at the average pickup locations are approx. -75 km/sec (approx. -12), approx. 4 x 10 to the 6th power K (approx. 1 x 10 to the 5th power), approx. 20 / cu cm (approx. 400), and approx. .15 / cu cm/sec (approx. 3.6). Gradients in the plasma properties between these two regions are quite strong. Implications of our inferred plasma properties for the near-nucleus region and for cometary magnetotail formation are examined. DOE

N87-21776# Los Alamos National Lab., N. Mex.
PULSATIONS OF B STARS: A REVIEW OF OBSERVATIONS AND THEORIES
A. N. Cox 1986 12 p Presented at the Stellar Pulsation Conference, Los Alamos, N. Mex., 11 Aug. 1986
(Contract W-7405-eng-36)
(DE87-003717; LA-UR-86-4110; CONF-8608130-8) Avail: NTIS HC A02/MF A01

The observational and theoretical status are discussed for several classes of variable B stars. The older classes now seem to be better understood in terms of those stars that probably have at least one radial mode and those that have only nonradial modes. The former are the Beta Cephei variables, and the latter are the slowly rotating 53 Persei and the rapidly rotating zeta Ophiuchi variables. It seems that in this last class there are also some Be stars that show nonradial pulsations from the variations of the line shapes and their light. Among the nonradial pulsators, we must also include the supergiants which show pulsations with very short lifetimes. A review of the present observational and theoretical problems is given. The most persistent problem of the

cause for the pulsations is briefly discussed, and many proposed mechanisms plus some new thoughts are presented. DOE

N87-21777# Academy of Sciences of the Ukrainian SSR, Kiev.
ON THE MASS LOSS RATE BY THE NUCLEI OF PLANETARY NEBULAE
1985 12 p In RUSSIAN; In RUSSIAN
(DE87-701325; ITF-85-118-R) Avail: NTIS (US Sales Only) HC A02/MF A01

A type of dependence of the expansion velocity in planetary nebula (PN) on its radius that describes well the observed character of PN expansion is proposed. An analytical expression for mass loss rate by the nebula nucleus, that provides the observed expansion of nebula, is obtained in the model of fast and slow stellar winds. DOE

N87-21778# Fermi National Accelerator Lab., Batavia, Ill.
INFLATION IN THE UNIVERSE, CIRCA 1986
M. S. Turner Dec. 1986 25 p Presented at the 11th International Conference on General Relativity and Gravitation, Stockholm, Sweden, 1 Jul. 1986 Prepared in cooperation with Chicago Univ., Ill.
(Contract DE-AC02-76CH-03000)
(DE87-005399; FNAL/C-86/168-A; CONF-8607113-1) Avail: NTIS HC A02/MF A01

The hot big bang (standard) cosmology provides a reliable and tested accounting of the Universe from 0.01 sec after the bang until today, some 15 Gyr later. However, very special initial data seem to be required to account for the smoothness and flatness of our Hubble volume and for the existence of the small primeval density inhomogeneities required for the formation of structure in the Universe. Inflation offers a means to account for these special initial data which is based on physics at sub-planck energy scales (somewhat less than m/sub pl/ approx. = 10 to the 19th power GeV) and is motivated by contemporary ideas in particle theory. At present essentially all inflationary models involve a very weakly-coupled (quantified by the presence of a dimensionless parameter of order 10 to the -12 or so) scalar field which is displaced from the minimum of its potential. Regions of the Universe where the scalar field is initially displaced from its minimum undergo inflation as the scalar field relaxes, resulting in a Universe today which resembles ours in regions much larger than our present Hubble volume (approx 10 to the 28 cm), but which on very large scales (somewhat more than 10 to the 28 cm) may be highly irregular. At present, the most conspicuous blemish on the paradigm is the lack of a compelling particle physics model to implement it. Some other unresolved issues facing inflation, including the confrontation between inflation and observational data are also reviewed. DOE

N87-21779# Fermi National Accelerator Lab., Batavia, Ill. Theoretical Astrophysics Group.
INFLATION IN SPHERICALLY SYMMETRIC INHOMOGENEOUS MODELS
J. A. Stein-Schabes Nov. 1986 20 p
(Contract DE-AC02-76CH-03000)
(DE87-005405; FNAL/Pub-86/159-A) Avail: NTIS HC A02/MF A01

Exact analytical solutions of Einstein's equations are found for a spherically symmetric inhomogeneous metric in the presence of a massless scalar field with a flat potential. The process of isotropization and homogenization is studied in detail. It is found that the time dependence of the metric becomes de Sitter for large times. Two cases are studied. The first deals with a homogeneous scalar field, while the second with a spherically symmetric inhomogeneous scalar field. In the former case the metric is of the Robertson-Walker form, while the latter is intrinsically inhomogeneous. DOE

N87-21780*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE HYDROGEN COVERAGE OF INTERSTELLAR PAHs
A. G. G. M. Tielens, L. J. Allamandola, J. R. Barker (Michigan Univ., Ann Arbor), and M. Cohen (California Univ., Berkeley) Feb. 1986 13 p Presented at the Conference on Polycyclic Aromatic Hydrocarbons and Astrophysics, Les Houches, France, 1 Feb. 1986 Submitted for publication
(Contract DE-FG02-85ER-13442)
(NASA-TM-89340; NAS 1.15:89340; DE87-003376; CONF-8602110-2) Avail: NTIS HC A02/MF A01 CSCL 03B

The rate at which the CH bond in interstellar Polycyclic Aromatic Hydrocarbons (PAHs) rupture due to the absorption of a UV photon has been calculated. The results show that small PAHs (less than or equal to 25 carbon atoms) are expected to be partially dehydrogenated in regions with intense UV fields, while large PAHs (greater than or equal to 25 atoms) are expected to be completely hydrogenated in those regions. Because estimate of the carbon content of interstellar PAHs lie in the range of 20 to 25 carbon atoms, dehydrogenation is probably not very important. Because of the absence of other emission features besides the 11.3 micrometer feature in ground-based 8 to 13 micrometer spectra, it has been suggested that interstellar PAHs are partially dehydrogenated. However, IRAS 8 to 22 micrometer spectra of most sources that show strong 7.7 and 11.2 micrometer emission features also show a plateau of emission extending from about 11.3 to 14 micrometer. Like the 11.3 micrometer feature, this new feature is attributed to the CH out of plane bending mode in PAHs. This new feature shows that interstellar PAHs are not as dehydrogenated as estimated from ground-based 8 to 13 micrometer spectra. It also constrains the molecular structure of interstellar PAHs. In particular, it seems that very condensed PAHs, such as coronene and circumcoronene, dominate the interstellar PAH mixture as expected from stability arguments. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N87-21781*# Hawaii Univ., Honolulu. Planetary Geosciences Div.
SPECTRAL REFLECTANCE (0.4 - 5.0 MICRONS) OF SULFUR RELATED COMPOUNDS AND MIXTURES Final Technical Report
Jonathan C. Gradie 1 Apr. 1987 12 p
(Grant NAGw-726)
(NASA-CR-180525; NAS 1.26:180525) Avail: NTIS HC A02/MF A01 CSCL 03B

Studied and quantified were: (1) the spectral properties of sulfur related compounds and materials; (2) the effects of thermal history, temperature and mixing ratios on the spectral properties of these materials; and (3) the application of these results to the Jovian system, in particular, the surfaces of Io, Europa, and Amalthea, and the chromophores in the Jovian atmosphere. Major results of the study include: (1) a study of how sulfur deposition affects the band strengths in various silicates; (2) a study of how the ultraviolet absorption band of sulfur is affected by dilution in ice; (3) the application of these two sets of experimental studies to Io, in the case of silicate band strengths, and Europa, as in the case of sulfur dilution in ices. Author

N87-21782# Los Alamos National Lab., N. Mex.
DUST-GAS INTERACTION DEDUCED FROM HALLEY MULTI-COLOUR CAMERA OBSERVATIONS
W. F. Huebner, W. A. Delamere, H. U. Keller, H. J. Reitsema, H. U. Schmidt, F. L. Whipple, and K. Wilhelm 1986 5 p Presented at the 20th ESLAB Symposium, Heidelberg, West Germany, 27 Oct. 1986 Prepared in cooperation with Ball Aerospace Systems Div., Boulder, Colo., Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany, Man-Planck-Inst. fuer Physik und Astrophysik, Garching, West Germany and Smithsonian Astrophysical Observatory

(Contract W-7405-eng-36)
(DE87-003426; LA-UR-86-3907; CONF-8610207-5) Avail: NTIS HC A02/MF A01

The dust and gas productions of Comet Halley were measured by the dust counter and the mass spectrometers on the Giotto spacecraft. These instruments give only little information about the spatial asymmetry of the activity. The asymmetry in the dust production is clearly evident from the dust jets seen in the Halley Multicolor Camera images. Since the dust is entrained by the gas, production must be similarly asymmetric. The intensity profiles along and across several dust jets are related to their source regions on the nucleus. Properties of the dust jets are investigated. A few compact, but highly active source regions on the nucleus produce most of the visible dust and can account for most of the gas produced by the comet. DOE

N87-21783# Los Alamos National Lab., N. Mex.
MODEL ION ABUNDANCES FOR COMET HALLEY
W. F. Huebner, D. C. Boice, J. J. Keady, H. U. Schmidt, and R. Wegman 27 Oct. 1986 6 p Presented at the 20th ESLAB Symposium, Heidelberg, West Germany, 27 Oct. 1986 Prepared in cooperation with Max-Planck-Institut fuer Physik und Astrophysik, Garching, West Germany
(Contract W-7405-eng-36)
(DE87-003710; LA-UR-86-3908; CONF-8610207-2) Avail: NTIS HC A02/MF A01

A computer model for comet comae has been applied to predict ion abundances for comet Halley. It is assumed that the volatile component of the nucleus is 85% water and that the remaining volatile molecules are composed of carbon, nitrogen, oxygen, and sulfur. Model parameters such as heliocentric distance, size, and albedo are chosen to be consistent with the 13 to 14 March 1986 encounter of the Giotto spacecraft with the comet. Photoprocesses, gas-phase chemical kinetics, coma energy balance including a separate electron temperature, multifluid hydrodynamics with a transition to free molecular flow, fast streaming atomic and molecular hydrogen, and counter and cross streaming of species in the coma-solar wind interaction are taken into consideration. A comparison of the model results is made with preliminary data from the ion mass spectrometer at 6000 and 1500 km from the nucleus. We find good overall agreement. The implication of the coma physics and chemistry is discussed. DOE

N87-21784# Los Alamos National Lab., N. Mex.
THE P/GIACOBINI-ZINNER MAGNETOTAIL
J. A. Slavin, E. J. Smith, P. W. Daly, K. R. Flammer, G. Gloeckler, B. A. Goldberg, D. J. McComas, F. L. Scarf, and J. L. Steinberg 1986 8 p Presented at the 20th ESLAB Symposium, Heidelberg, West Germany, 27 Oct. 1986 Prepared in cooperation with JPL, Pasadena, Calif, Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany, California Univ., San Diego, La Jolla, Maryland Univ., College Park and TRW Space and Technology Group, Redondo Beach, Calif.
(Contract W-7405-eng-36)
(DE87-003761; LA-UR-86-4362; CONF-8610207-1) Avail: NTIS HC A02

On September 11, 1985 the International Cometary Explorer passed behind Comet Giacobini-Zinner with a closest approach distance of 7800 km. In agreement with Alfven's interplanetary magnetic field line draping model of cometary type I tails, a well defined 1 x 10 to the 4th power km diameter magnetotail was observed downstream of the inner coma. This study uses the ICE magnetic field, plasma electron, plasma wave, and energetic ion observations to investigate the structure and stability of the Giacobini-Zinner magnetic tail. Emphasis is placed on the identification of differences and similarities between cometary and planetary magnetotails. Finally, the ICE magnetotail observations are discussed in relation to the global solar wind interaction with P/Giacobini-Zinner magnetic tail. DOE

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation*.

N87-21785*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RAPID FLUCTUATIONS IN SOLAR FLARES
Brian R. Dennis, ed., Larry E. Orwig, ed., and Alan L. Kiplinger, ed. (Systems Applied Sciences Corp.-Technologies, Landover, Md.) 1986 491 p Workshop held in Lanham, Md., 30 Sep. - 4 Oct. 1985
(NASA-CP-2449; NAS 1.55:2449) Avail: NTIS HC A21/MF A01 CSCL 03B

Topics addressed include: X-rays; radio and microwaves; thermal response; plasma physics; and future plans. For individual titles, see N87-21786 through N87-21833.

N87-21786*# Stanford Univ., Calif. Center for Space Science and Astrophysics.
RAPID FLUCTUATIONS IN SOLAR FLARES
Peter A. Sturrock *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 1-28 (For primary document see N87-21785 14-92)
(Grants NAGw-92; NGL-05-020-272; Contract N00014-85-K-0111) Avail: NTIS HC A21/MF A01 CSCL 03B

Study of rapid fluctuations in the emission of radiation from solar flares provides a promising approach for probing the magneto-plasma structure and plasma processes that are responsible for a flare. It is proposed that elementary flare bursts in X-ray and microwave emission may be attributed to fine structure of the coronal magnetic field, related to the aggregation of photospheric magnetic field into magnetic knots. Fluctuations that occur on a subsecond time-scale may be due to magnetic islands that develop in current sheets during magnetic reconnection. The impulsive phase may sometimes represent the superposition of a large number of the elementary energy-release processes responsible for elementary flare bursts. If so, the challenge of trying to explain the properties of the impulsive phase in terms of the properties of the elementary processes must be faced. Magnetic field configurations that might produce solar flares are divided into a number of categories, depending on: whether or not there is a filament; whether there is no current sheet, a closed current sheet, or an open current sheet; and whether the filament erupts into the corona, or is ejected completely from the Sun's atmosphere. Analysis of the properties of these possible configurations is compared with different types of flares, and to Bai's subdivision of gamma-ray/proton events. Author

N87-21787*# Stanford Univ., Calif.
SUB-SECOND VARIATIONS OF HIGH ENERGY (< 300 keV) HARD X-RAY EMISSION FROM SOLAR FLARES
Taeil Bai *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 29-33 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Subsecond variations of hard X-ray emission from solar flares were first observed with a balloon-borne detector. With the launch of the Solar Maximum Mission (SMM), it is now well known that subsecond variations of hard X-ray emission occur quite frequently. Such rapid variations give constraints on the modeling of electron energization. Such rapid variations reported until now, however, were observed at relatively low energies. Fast mode data obtained by the Hard X-ray Burst Spectrometer (HXRBS) has time resolution of approximately 1 ms but has no energy resolution. Therefore, rapid fluctuations observed in the fast-mode HXRBS data are dominated by the low energy hard X-rays. It is of interest to know whether rapid fluctuations are observed in high-energy X-rays. The highest energy band at which subsecond variations were observed is 223 to 1057 keV. Subsecond variations observed with HXRBS at energies greater than 300 keV are reported, and the implications discussed. Author

N87-21788*# Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.
INTERPRETATION OF RAPID RISES IN HARD X-RAYS AND MICROWAVES WITH THE THERMAL CONDUCTION FRONT MODEL
D. A. Batchelor *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 29-45 (For primary document see N87-21785 14-92)
(Grants NsG7-055; NSF ATM-83-12720)
Avail: NTIS HC A21/MF A01 CSCL 03B

Impulsive hard X-ray and microwave bursts with rise times from 0.1 to 10 seconds are discussed. Source areas calculated by the method of Crannell et al. (1978) were compared with source areas determined from Hinotori and the Hard X-ray Imaging Spectrometer (HXIS) images. The agreement strongly suggests that the method is valid. If the thermal conduction front model for the hard X-ray and microwave source is adopted, then the method enables derivation of area, density, magnetic field, and rise time from hard X-ray and microwave spectral observations. This approach was used to derive these parameters for several rapid impulsive rises in the flares of July 1, 1980, and May 21, 1984. It is shown that the model provides a consistent interpretation of the observations of these impulsive increases. Indeed, the model provides a way to calculate rise times from spectra alone (to within a factor of about three) over more than two orders of magnitude. Author

N87-21789*# California Univ., Irvine. Dept. of Physics.
IMPULSIVE PHASE SOLAR FLARE X-RAY POLARIMETRY
Gary Chanan, A. Gordon Emslie (Alabama Univ., Huntsville.), and Robert Novick (Columbia Univ., New York.) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 47-62 (For primary document see N87-21785 14-92)
(Grants NAG5-618; NAGw-588; NAGw-93; NAGw-294; NSF ATM-85-05475)
Avail: NTIS HC A21/MF A01 CSCL 03B

The pioneering observational work in solar flare X-ray polarimetry was done in a series of satellite experiments by Tindo and his collaborators in the Soviet Union; initial results showed high levels of polarization in X-ray flares (up to 40%), although of rather low statistical significance, and these were generally interpreted as evidence for strong beaming of suprathermal electrons in the flare energy release process. However, the results of the polarimeter flown by the Columbia Astrophysics Laboratory as part of the STS-3 payload on the Space Shuttle by contrast showed very low levels of polarization. The largest value (observed during the impulsive phase of a single event) was 3.4% + or - 2.2%. At the same time but independent of the observational work, Leach and Petrosian (1983) showed that the high levels of polarization in the Tindo results were difficult to understand theoretically, since the electron beam is isotropized on an energy loss timescale. A subsequent comparison by Leach, Emslie, and Petrosian (1985) of the impulsive phase STS-3 result and the above theoretical treatment shows that the former is consistent with several current models and that a factor of approximately 3 improvement in sensitivity is needed to distinguish properly among the possibilities. Author

N87-21790*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PERSISTENT TIME INTERVALS BETWEEN FEATURES IN SOLAR FLARE HARD X-RAY EMISSION
Upendra D. Desai, Chryssa Kouveliotou, C. Barat (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), K. Hurley, M. Niel, R. Talon, and G. Vedrenne *In its* Rapid Fluctuations in Solar Flares 1986 p 63-74 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Several solar hard X-ray events (greater than 100 keV) were observed simultaneously with identical instruments on the Venera 11, 12, 13, 14, and Prognoz spacecraft. High time resolution (= 2 ms) data were stored in memory when a trigger occurred. The observations of modulation are presented with a period of 1.6 s for the event on December 3, 1978. Evidence is also presented for fast time fluctuations from an event on November 6, 1979, observed from Venera 12 and another on September 6, 1981, observed from the Solar Maximum Mission. Power spectrum analysis, epoch folding, and Monte Carlo simulation were used to evaluate the statistical significance of persistent time delays between features. The results are discussed in light of the MHD model proposed by Zaitsev and Stepanov. Author

N87-21791*# Tuebingen Univ. (West Germany). Lehrstuhl fuer Theoretische Astrophysik.
EVIDENCE FOR BEAMED ELECTRONS IN A LIMB X-RAY FLARE OBSERVED BY HARD X-RAY IMAGING SPECTROMETER (HXIS)
Eberhard Haug and Gerhard Elwert *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 75-78 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The limb flare of November 18, 1980, 14:51 UT, was investigated on the basis of X-ray images taken by the Hard X-ray Imaging Spectrometer (HXIS) and of X-ray spectra from the Hard X-Ray Burst Spectrometer (HXRBS) aboard the Solar Maximum Mission (SMM). The impulsive burst was also recorded at microwave frequencies between 2 and 20 GHz whereas no optical flare and no radio event at frequencies below 1 GHz were reported. The flare occurred directly at the SW limb of the solar disk. Taking advantage of the spatial resolution of HXIS images, the time evolution of the X-radiation originating from relatively small source regions can be studied. Using Monte Carlo computations of the energy distribution of energetic electrons traversing the solar plasma, the bremsstrahlung spectra produced by the electrons were derived. B.G.

N87-21792*# Observatoire de Paris-Meudon (France).
A STUDY OF STARTING TIME IN GREAT HARD X-RAY FLARES
K. L. Klein, M. Pick, and A. Magun (Institut fuer Angewandte Physik, Bern, Switzerland) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 79-84 Sponsored in part by CNES, CNRS and ESA (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

An analysis of the starting time in ten great hard X-ray bursts observed with the X-Ray Burst Spectrometer (HXRBS) is presented. It is shown that the impulsive phase of nine of them is composed of a preflash phase, during which the burst is observed up to an energy limit ranging from some tens of keV to 200 keV, followed ten to some tens of seconds afterwards by a flash phase, where the count rate rises simultaneously in all detector channels. For two events strong gamma-ray line emission is observed and is shown to start close to the onset of the flash phase. Author

N87-21793*# Nanjing Univ. (China). Dept. of Astronomy.
STATISTICAL ANALYSIS OF FAST HARD X-RAY BURSTS BY SMM OBSERVATIONS AND MICROWAVE BURSTS BY GROUND-BASED OBSERVATIONS
Chun-sheng Li and Shu-ying Jiang *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 85-90 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

In order to understand the relationship between fast hard X-ray bursts (HXRB) and microwave bursts (MWB), data were used from the following publications: NASA Technical Memorandum 84998; Solar Geological Data (1980 to 1983); monthly report of Solar Radio Emission; and NASA and NSF: Solar Geophysical Data (1980 to 1983). For analyzing individual events, the criterion of the same event for HXRB and MWB is determined by peak time difference. There is a good linear correlation between the physical parameter of HXRB and MWB. B.G.

N87-21794*# Nanjing Univ. (China). Dept. of Astronomy.
MICROWAVE AND HARD X-RAY EMISSIONS DURING THE IMPULSIVE PHASE OF SOLAR FLARES: NONTHERMAL ELEC-

TRON SPECTRUM AND TIME DELAY
Ye-ming Gu and Chung-sheng Li *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 91-109 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

On the basis of the summing-up and analysis of the observations and theories about the impulsive microwave and hard X-ray bursts, the correlations between these two kinds of emissions were investigated. It is shown that it is only possible to explain the optically-thin microwave spectrum and its relations with the hard X-ray spectrum by means of the nonthermal source model. A simple nonthermal trap model in the mildly-relativistic case can consistently explain the main characteristics of the spectrum and the relative time delays. Author

N87-21795*# Tokyo Astronomical Observatory, Mitaka (Japan).
HARD X-RAY IMAGING OBSERVATION OF FLUCTUATING BURSTS
K. Ohki and M. Harada (Tokyo Science Univ., Japan) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 111-119 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Measurements were done to obtain the one-dimensional sizes of rapidly fluctuating bursts with fast spikes whose rise times are typically about one second, and in some extreme cases less than 0.1 second. The results of two bursts with fast spikes are presented. One has a soft spectrum, and the other has a very hard spectrum. The measured one-dimensional size of both events indicates relatively a small size and simple structure. It can be said, however, that the source size is not so small as expected from its rapid time variations. Therefore, a thermal explanation of these bursts seems to be excluded. Author

N87-21796*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HARD X-RAY DELAYS Abstract Only
Richard A. Schwartz *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 121 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

High time resolution hard X-ray rates with good counting statistics over 5 energy intervals were obtained using a large area balloon-borne scintillation detector during the 27 June 1980 solar flare. The impulsive phase of the flare was comprised of a series of major bursts of several to several tens of seconds long. Superimposed on these longer bursts are numerous smaller approximately 0.5 to 1.0 second spikes. The time profiles for different energies were cross-correlated for the major bursts. The rapid burst decay rates and the simultaneous peaks below 120 keV both indicate a rapid electron energy loss process. Thus, the flux profiles reflect the electron acceleration/injection process. The fast rate data was obtained by a burst memory in 8 and 32 msec resolution over the entire main impulsive phase. These rates will be cross-correlated to look for short time delays and to find rapid fluctuations. However, a cursory examination shows that almost all fluctuations, down to the 5% level, were resolved with 256 msec bins. Author

N87-21797*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FAST FLUCTUATIONS OF SOFT X-RAYS FROM ACTIVE REGIONS
G. F. Simnett (Birmingham Univ., England) and B. R. Dennis *In its* Rapid Fluctuations in Solar Flares 1986 p 123-130 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

A selection of short lived small soft X-ray bursts is studied using data from the Hard X-ray Imaging Spectrometer (HXIS), and the results are compared with the data from the Hard X-Ray Burst Spectrometer (HXRBS) with a view to understanding conditions at the onset of flares. Short-lived events provide an opportunity to study the radiation from the primary energy transfer process without confusion from the slowly-varying thermal X-ray emission which characterizes the decay of a large flare. The fast decay of the soft X-rays, only a few tens of seconds, suggests that they occur in the dense chromosphere. The results indicate that the short events may be signatures of several different phenomena, depending on their characteristics. Some events occur in association with reverse-drift type III bursts and simultaneous flaring elsewhere on the Sun, thus suggesting dumping of particles accelerated at a remote site. Some events have hard X-ray bursts and normal type III bursts associated with them, while others have neither. The latter events place strong constraints on the nonthermal electron population present. Author

N87-21798*# Eidgenoessische Technische Hochschule, Zurich (Switzerland).
EXTREMELY RAPID RADIO SPIKES IN FLARES: A REVIEW
A. O. Benz *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 133-144 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Radio spikes of a few to tens of milliseconds of the solar radio emission have recently seen a surge of interest of theoreticians who are fascinated by their high brightness temperature of up to 10 to the 15th power K, their association with hard X-ray bursts, and a possibly very intimate relation to electron acceleration. Their bandwidth and global distribution in frequency were quantitatively measured only recently. This review is intended to emphasize the considerable extend of old and new observational knowledge which is hardly touched upon by theory. The wide range of spike observations is summarized and brought into perspective of recent models. It is concluded that spikes yield a considerable potential for the diagnostics of energetic particles, their origin, and history in astrophysical plasmas. Author

N87-21799*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATION BETWEEN SOLAR NARROW-BAND DECIMETER WAVE BURSTS AND ASSOCIATED X-RAY BURSTS Abstract Only
Shinzo Enome (Nagoya Univ., Japan) and Larry E. Orwig *In its* Rapid Fluctuations in Solar Flares 1986 p 145 Submitted for publication (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Results are reported of an initial comparison of solar narrow-band decimeter wave spike bursts with corresponding X-ray events for 25 solar flares. Contrary to the rather straighforward temporal and spatial relations which exist between typical impulsive microwave and X-ray bursts, narrow-band decimeter wave spike bursts show complex temporal structure relative to the associated X-ray features. The time delay between the hard X-ray and microwave emission peaks varies from -2 to 8 seconds. The associated X-ray events are very weak in intensity, are spectrally very soft, and do not show any peculiar spectral features. Although the total number of bursts is small, it is found that decimeter spike bursts are 100 to 1000 times stronger than normal impulsive microwave bursts for the same observed amount of hard X-ray emission. This feature, supplemented by the fact that 100% circular polarization is observed, strongly supports a maser origin for the decimeter spike bursts. Author

N87-21800*# Tokyo Astronomical Observatory, Mitaka (Japan).
POSITION MEASUREMENTS OF RAPIDLY FLUCTUATING MICROWAVE BURSTS
K. Kai and H. Nakajima *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 147-153 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

It was investigated whether microwave source positions change while the total fluxes of hard X-rays and microwaves show remarkable rapid fluctuations of the order of seconds. The position measurements were made in one dimension (east-west direction) with the 17 GHz interferometer at Nobeyama. Position changes greater than a few arc seconds can be detected. The result shows that significant position changes are found for five of seven bursts

but that no position changes greater than 3 arc seconds are found for the remaining two bursts. Author

N87-21801*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Astronomical Inst. of the Czechoslovak.

THE ROLE OF NARROWBAND dm-SPIKES IN SOLAR FLARES

Marian Karlicky *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 155-160 (For primary document see N87-21785 14-92)

Avail: NTIS HC A21/MF A01 CSCL 03B

The main observational characteristics of narrowband dm-spikes are summarized. Since the spikes are observed in typical sequences of radio bursts, a global model of these bursts is presented. The intensity of the magnetic field in the spike source region, which is of principal importance, is discussed. Author

N87-21802*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE POSSIBLE IMPORTANCE OF SYNCHROTRON/INVERSE COMPTON LOSSES TO EXPLAIN FAST mm-WAVE AND HARD X-RAY EMISSION OF A SOLAR EVENT

E. Correia (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil), P. Kaufmann, J. E. R. Costa, A. M. ZodiVaz, and B. R. Dennis *In its* Rapid Fluctuations in Solar Flares 1986 p 161-169 Previously announced as N86-25316 (For primary document see N87-21785 14-92)

Avail: NTIS HC A21/MF A01 CSCL 03B

The solar burst of 21 May 1984, presented a number of unique features. The time profile consisted of seven major structures (seconds), with a turnover frequency of greater than or approximately 90 GHz, well correlated in time to hard X-ray emission. Each structure consisted of multiple fast pulses (0.1 seconds), which were analyzed in detail. A proportionality between the repetition rate of the pulses and the burst fluxes at 90 GHz and greater than or approximately 100 keV hard X-rays, and an inverse proportionality between repetition rates and hard X-ray power law indices were found. A synchrotron/inverse Compton model was applied to explain the emission of the fast burst structures, which appear to be possible for the first three or four structures. Author

N87-21803*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

RAPID SPECTRAL AND FLUX TIME VARIATIONS IN A SOLAR BURST OBSERVED AT VARIOUS dm-mm WAVELENGTHS AND AT HARD X-RAYS

A. M. ZodiVaz, P. Kaufmann, E. Correia, J. E. R. Costa, T. Takakura (Tokyo Univ., Japan.), E. W. Cliver (Air Force Geophysics Lab., Hanscom AFB, Mass.), and K. F. Tapping (National Research Council of Canada, Ottawa, Ontario.) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 171-183 Previously announced as N86-29755 Sponsored in part by FINEP (For primary document see N87-21785 14-92)

Avail: NTIS HC A21/MF A01 CSCL 03B

A solar burst was observed with high sensitivity and time resolution at cm-mm wavelengths by two different radio observatories (Itapetinga and Algonquin), with high spectral time resolution at dm-mm wavelengths by patrol instruments (Sagamore Hill), and at hard X-rays (HXM Hinotori). At the onset of the major burst time structure there was a rapid rise in the spectral turnover frequency (from 5 to 15 GHz), in about 10s, coincident to a reduction of the spectral index in the optically thin part of the spectrum. The burst maxima were not time coincident at the optically thin radio frequencies and at the different hard X-ray energy ranges. The profiles at higher radio frequencies exhibited better time coincidence to the high energy X-rays. The hardest X-ray spectrum (-3) coincided with peak radio emission at the higher frequency (44 GHz). The event appeared to be built up by a first major injection of softer particles followed by other injections of harder particles. Ultrafast time structures were identified as superimposed on the burst emission at the cm-mm high sensitivity data at X-rays, with predominant repetition rates ranging from 2.0 to 3.5 Hz. Author

N87-21804*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

QUASI-PERIODIC PULSATIONS IN SOLAR HARD X-RAY AND MICROWAVE FLARES

Takeo Kosugi and Alan L. Kiplinger *In its* Rapid Fluctuations in Solar Flares 1986 p 185-191 Prepared in cooperation with Systems and Applied Sciences Corp., Lanham, Md. (For primary document see N87-21785 14-92)

Avail: NTIS HC A21/MF A01 CSCL 03B

For more than a decade, various studies have pointed out that hard X-ray and microwave time profiles of some solar flares show quasi-periodic fluctuations or pulsations. Nevertheless, it was not until recently that a flare displaying large amplitude quasi-periodic pulsations in X-rays and microwaves was observed with good spectral coverage and with a sufficient time resolution. The event occurred on June 7, 1980, at approximately 0312 UT, and exhibits seven intense pulses with a quasi-periodicity of approximately 8 seconds in microwaves, hard X-rays, and gamma-ray lines. On May 12, 1983, at approximately 0253 UT, another good example of this type of flare was observed both in hard X-rays and in microwaves. Temporal and spectral characteristics of this flare are compared with the event of June 7, 1980. In order to further explore these observational results and theoretical scenarios, a study of nine additional quasi-periodic events were incorporated with the results from the two flares described. Analysis of these events are briefly summarized. B.G.

N87-21805*# Nanjing Univ. (China). Dept. of Astronomy.

MICROWAVE MILLISECOND SPIKE EMISSION AND ITS ASSOCIATED PHENOMENA DURING THE IMPULSIVE PHASE OF LARGE FLARES

Chunsheng Li, Shuying Jiang, Hongwei Li, and Qijun Fu (Academia Sinica, Beijing, China) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 193-204 (For primary document see N87-21785 14-92)

Avail: NTIS HC A21/MF A01 CSCL 03B

A tentative model is proposed to account for some features of the microwave millisecond spike emission and its links with the physical processes of associated phenomena during the impulsive phase of large flares by comparing the optical, radio, and X-ray observations on May 16, 1981 to those on October 12, 1981. Author

N87-21806*# Bern Univ. (Switzerland). Inst. of Applied Physics.

THE MICROWAVE SPECTRUM OF SOLAR MILLISECOND SPIKES

M. Staehli and A. Magun *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 205-210 Previously announced in IAA as A86-47188 Sponsored in part by Swiss National Science Foundation (For primary document see N87-21785 14-92)

Avail: NTIS HC A21/MF A01 CSCL 03B

The microwave radiation from solar flares sometimes shows short and intensive spikes which are superimposed on the burst continuum. In order to determine the upper frequency limit of their occurrence and the circular polarization, a statistical analysis was performed on digital microwave observations from 3.2 to 92.5 GHz. Additionally, fine structures were investigated with a fast 32-channel spectrometer at 3.47 GHz. It was found that about 10 percent of the bursts show fine structures at 3.2 and 5.2 GHz, whereas none occurred above 8.4 GHz. Most of the observed spikes were very short and their bandwidth varied from below 0.5 MHz to more than 200 MHz. Simultaneous observations at two further frequencies showed no coincident spikes at the second and third harmonic. The observations can be explained by the theory of electron cyclotron masering if the observed bandwidths are determined by magnetic field inhomogeneities or if the rise times are independent of the source diameters. The latter would imply source sizes between 50 and 100 km. Author

N87-21807*# National Research Council of Canada, Ottawa (Ontario).
SOLAR VLBI
K. F. Tapping and J. Kuijpers (Utrecht State Univ., Netherlands) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 211-214 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

In April, 1981, radio telescopes at Dwingeloo (The Netherlands) and Onsala (Sweden) were used as a long-baseline interferometer at a wavelength of 18 cm. The baseline of 619 km gave a spatial resolution on the Sun of about 45 km. The major problems of Solar Very Long Baseline Interferometry are discussed. B.G.

N87-21808*# National Geophysical Data Center, Boulder, Colo.
TEMPORAL FREQUENCY OF RADIO EMISSIONS FOR THE APRIL 25, 1984 FLARE
G. D. Wells, B. A. Hausman, and H. W. Kroehl *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 215-235 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The National Geophysical Data Center archives data of the solar-terrestrial environment. The USAF Radio Solar Telescope Network (RSTN) data allow performance of time series analysis to determine temporal oscillations as low as three seconds. The X13/3B flare which erupted in region 4474 (S12E43) on the 24 to 25 of April 1984, was selected. The soft X-rays, 1 to 8 A, remained above X-levels for 50 minutes and the radio emissions measured at Learmonth Solar Observatory reached a maximum of 3.15 x 10 to the 5th power SFUs at 410 MHz at 0000UT. A power spectral analysis of the fixed frequency RSTN data from Learmonth shows possible quasi-periodic fluctuations in the range two to ten seconds. Repetition rates or quasi-periodicities, in the case of the power spectral analysis, generally showed the same trends as the average solar radio flux at 245 and 8800 MHz. The quasi-periodicities at 1415 MHz showed no such trends. Author

N87-21809*# Maryland Univ., College Park.
SOLAR MICROWAVE MILLISECOND SPIKE AT 2.84 GHz
Qi-jun Fu, Sheng-zhen Jin (Academia Sinica, Beijing, China), Ren-yang Zhao, Le-ping Zheng, Yu-ying Liu, Xiao-cong Li, Shu-lan Wang, Zhi-jun Chen, and Chu-min Hu *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 237-247 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Using the high time resolution of 1 ms, the data of solar microwave millisecond spike (MMS) event was recorded more than two hundred times at the frequency of 2.84 GHz at Beijing (Peking) Observatory since May 1981. A preliminary analysis was made. It can be seen from the data that the MMS-events have a variety of the fast activities such as the dispersed and isolated spikes, the clusters of the crowded spikes, the weak spikes superimposed on the noise background, and the phenomena of absorption. The marked differences from that observed with lower time resolution are presented. Using the data, a valuable statistical analysis was made. There are close correlations between MMS-events and hard X-ray bursts, and fast drifting bursts. The MMS events are highly dependent on the type of active regions and the magnetic field configuration. It seems to be crucial to find out the accurate positions on the active region where the MMS-events happen and to make co-operative observations at different bands during the special period when specific active regions appear on the solar disk. Author

N87-21810*# California Univ., San Diego.
THE SENSITIVITY OF H ALPHA PROFILES TO RAPID ELECTRON BEAM FLUCTUATIONS
Richard C. Canfield and Kenneth G. Gayley *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 249-261 (For primary document see N87-21785 14-92)
(Grants NsG-7406; NSF ATM-84-15793)
Avail: NTIS HC A21/MF A01 CSCL 03B

In order to understand the temporal relationship between H alpha and hard X-ray emission predicted by the nonthermal electron thick target model of impulsive-phase energy transport the time-dependent theoretical H alpha profiles were computed for the dynamic model atmospheres of Fisher, Canfield, and McClymont, which simulate the effects of an impulsively initiated power-law beam of electrons. On the basis of the physical analysis it was expected that a very rapid H alpha response to an instantaneous increase in the flux of a nonthermal deka-keV electron beam, as compared to the timescale associated with the propagation of these electrons over characteristic flare coronal loop spatial scales. It was concluded that observational efforts to test the thick target nonthermal electron model through detection of impulsive H alpha brightenings associated with impulsive hard X-ray or microwave bursts should initially focus attention on the H alpha line center. Additional simultaneous blue-wing measurements will have substantial diagnostic potential. Author

N87-21811*# Naval Research Lab., Washington, D. C. Center for Space Research.
A SEARCH FOR FAST VARIATIONS IN THE Fe XXI EMISSION DURING SOLAR FLARES
Chung-Chieh Cheng *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 163-269 (For primary document see N87-21785 14-92)
(NASA Order W-15367)
Avail: NTIS HC A21/MF A01 CSCL 03B

A search for fast variations in the Fe XXI emission was made for ten flares using the Fourier analysis. Three examples were described. The main results are summarized. B.G.

N87-21812*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FAST TEMPORAL CORRELATION BETWEEN HARD X-RAY AND ULTRAVIOLET CONTINUUM BRIGHTENINGS
Marcos E. Machado and Pablo J. Mauas (Instituto de Astronomia y Fisica del Espacio, Buenos Aires, Argentina) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 271-275 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Recent Solar Maximum Mission (SMM) observations have shown fast and simultaneous increases in hard X-rays (HXR, E>25 keV) and ultraviolet continuum (UVC, lambda lambda approx. equals 1600 and 1388 A) radiation. A simple and natural explanation is given for this phenomenon to happen, which does not involve extreme conditions for energy transport processes, and confirms earlier results on the effect of XUV photoionization in the solar atmosphere. Author

N87-21813*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPARISON OF SOLAR HARD X-RAY AND UV LINE AND CONTINUUM BURSTS WITH HIGH TIME RESOLUTION Abstract Only
L. E. Orwig and B. E. Woodgate *In its* Rapid Fluctuations in Solar Flares 1986 p 277 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The close temporal correlation between the ultraviolet line emission from OV (lambda 1371A) and hard X-rays above 30 keV has been previously established from a comparison of data sets from the Ultraviolet Spectrometer and Polarimeter (UVSP) and Hard X-Ray Burst Spectrometer (HXRBS) instruments on Solar Maximum Mission (SMM). Corresponding features were found to be coincident to within 1 s. Following the SMM repair, similar measurements were made for a flare occurring on May 20, 1984, at 0259 UT, this time with UVSP observing in the continuum near 1600A with much higher time resolution (75ms). The simultaneity of several features in this flare were established to better than 0.1 s, thus reinforcing the close relationship between hard X-ray and UV emission. Following the repair of the UVSP wavelength drive, similar measurements were repeated for a flare occurring at 0148 UT on April 24, 1985. This event was observed simultaneously in the OV line, the UV continuum and in hard X-rays by the same

SMM instruments. Temporal comparisons of the three data sets show that, for a few selected features, simultaneity of the hard X-ray and UV emissions does exist. However, cross-correlation analyses of the entire data sets indicate that there is a trend for the fastest OV emission features to be delayed with respect to the hard X-rays by approx. 260 ms. On the other hand the fast OV and UV continuum features are simultaneous to within the instrumental uncertainty. The combined results have established the close relationship of the impulsive phase hard X-ray and UV continuum and OV line emissions. They lend support to the argument that both the hard X-ray and UV radiations originate low in the solar atmosphere. Author

N87-21814*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OV AND HARD X-RAYS, OBSERVATIONS AND MODEL CALCULATIONS
A. I. Poland and J. T. Mariska (Naval Research Lab., Washington, D. C.) *In its* Rapid Fluctuations in Solar Flares 1986 p 279-287 Sponsored in part by Navy (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

An amalgamation of two published works that discuss the observation and theoretical calculations of OV (T approx. 250,000K) and Hard X-rays (30 to 100keV) emitted during flares are presented. The papers are by Poland et al (1984) and Mariska and Poland (1985). The observations of Hard X-rays and OV show that the excitation processes for each type of emission are closely coupled. Except for small differences the two types of emission rise and fall together during a flare. Model calculations are able to reproduce this behavior to a large extent, only when conductive processes do not dominate the energy transport processes. Author

N87-21815*# Applied Research Corp., Landover, Md.
RAPID SOFT X-RAY FLUCTUATIONS IN SOLAR FLARES OBSERVED WITH THE X-RAY POLYCHROMATOR
D. M. Zarro, J. L. R. Saba, and K. T. Strong (Lockheed Missiles and Space Co., Palo Alto, Calif.) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 289-298 Sponsored in part by Lockheed Independent Research Programme (For primary document see N87-21785 14-92)
(Contract NAS5-27613)
Avail: NTIS HC A21/MF A01 CSCL 03B

Three flares observed by the Soft X-Ray Polychromator on the Solar Maximum Mission were studied. Flare light curves from the Flat Crystal Spectrometer and Bent Crystal Spectrometer were examined for rapid signal variations. Each flare was characterized by an initial fast (less than 1 min) burst, observed by the Hard X-Ray Burst Spectrometer (HXRBS), followed by softer gradual X-ray emission lasting several minutes. From an autocorrelation function analysis, evidence was found for quasi-periodic fluctuations with rise and decay times of 10 s in the Ca XIX and Fe XXV light curves. These variations were of small amplitude (less than 20%), often coincided with hard X-ray emissions, and were prominent during the onset of the gradual phase after the initial hard X-ray burst. It is speculated that these fluctuations were caused by repeated energy injections in a coronal loop that had already been heated and filled with dense plasma associated with the initial hard X-ray burst. Author

N87-21816*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOFT X-RAY OSCILLATIONS DURING THE FLARE OF 7 AUGUST 1972 Abstract only
Roger J. Thomas, Werner M. Neupert, and William T. Thompson (Applied Research Corp., Landover, Md.) *In its* Rapid Fluctuations in Solar Flares 1986 p 299 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Unique observations from OSO-7 of the intense flare on 7 August 1972 are presented, showing 1.6 second oscillations in it's soft X-ray emission which are long enduring, extremely regular, and initially of large amplitude. For approximately 20 minutes just after flare maximum, the X-ray intensity of an area 20 arc second square near the flare's core was monitored with 160 millisecond time resolution in two channels, 2-8A and 8-16A. Each channel recorded over 700 cycles of the X-ray oscillations, which remained remarkably stable in phase and period throughout the entire observations, but with gradually diminishing amplitude. The observed period does not correspond to any known operational periodicity in either the instrument or the spacecraft and cannot be attributed to aliasing with any other oscillatory component. Channel ratios indicate that both the temperature and electron density of the emitting plasma are enhanced at the peak of each cycle. There is indirect evidence that the X-ray pulsations are occurring only in a relatively small portion of an elongated feature, presumed to be a loop or arcade of loops. Author

N87-21817*# Bern Univ. (Switzerland). Inst. of Applied Physics.
RAPID CHANGES IN H ALPHA-FLARES CORRELATED WITH MICROWAVES
J-P. Wuelser and N. Kaempfer *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 301-309 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The time evolution of several flares was studied in H alpha with a time resolution of 1.4 seconds. The time profiles of the linecenter intensity show fast fluctuations and spikes. During the impulsive phase, prominent spikes occur in different kernels and they are correlated with microwave and Hard X-ray spikes. Spectral resolved observations show major changes of the ratio between H alpha line width and H alpha linecenter intensity at time scales in the order of 1 minute. No significant fluctuations occurred at shorter time scales. Author

N87-21818*# Glasgow Univ. (Scotland). Dept. of Astronomy.
PLASMA TURBULENCE AND IMPULSIVE UV LINE EMISSION IN SOLAR FLARES
John C. Brown *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 311-317 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Observations show that hard X-ray burst and UV lines rise and fall simultaneously on time scales of seconds. Hydrodynamic simulations of beam-heated atmospheres, based on collisional transport, however, produce only a gradual fall in UV emission, when the beam flux falls, due to the long time scale of conductive relaxation. It is suggested that this discrepancy might be explained by onset of plasma turbulence driven by the strong heat flux or by the beam return current going unstable. Such turbulence greatly reduces electrical and thermal conductivities. Fall in electrical conductivity reduces the hard X-ray flux by enhanced ohmic dissipation of the return current, while fall in thermal conductivity may cause the UV line to fall by reducing the transition region thickness. Author

N87-21819*# Nanjing Univ. (China). Dept. of Astronomy.
ELECTRON-CYCLOTRON MASER AND SOLAR MICROWAVE MILLISECOND SPIKE EMISSION
Hong-wei Li, Chun-sheng Li, and Qi-jun Fu (Academia Sinica, Beijing, China) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 319-325 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

An intense solar microwave millisecond spike emission (SMMSE) event was observed on May 16, 1981 by Zhao and Jin at Beijing Observatory. The peak flux density of the spikes is high to 5 x 100,000 s.f.u. and the corresponding brightness temperature (BT) reaches approx. 10 to the 15th K. In order to explain the observed properties of SMMSE, it is proposed that a beam of electrons with energy of tens KeV injected from the acceleration region downwards into an emerging magnetic arch forms so called hollow beam distribution and causes electron-cyclotron maser (ECM) instability. The growth rate of second harmonic X-mode is calculated and its change with time is deduced. It is shown that

the saturation time of ECM is t sub s approx. equals 0.42 ms and only at last short stage (delta t less than 0.2 t sub s) the growth rate decreases to zero rather rapidly. So a SMMSE with very high BT will be produced if the ratio of number density of nonthermal electrons to that of background electrons, n sub s/n sub e, is larger than 4 x .00001. Author

N87-21820*# Glasgow Univ. (Scotland). Dept. of Astronomy.
THE EFFECT OF BEAM-DRIVEN RETURN CURRENT INSTABILITY ON SOLAR HARD X-RAY BURSTS
D. Cromwell, P. McQuillan, and J. C. Brown *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 327-339 Sponsored in part by SERC (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The problem of electrostatic wave generation by a return current driven by a small area electron beam during solar hard X-ray bursts is discussed. The marginal stability method is used to solve numerically the electron and ion heating equations for a prescribed beam current evolution. When ion-acoustic waves are considered, the method appears satisfactory and, following an initial phase of Coulomb resistivity in which T sub e/T sub i rise, predicts a rapid heating of substantial plasma volumes by anomalous ohmic dissipation. This hot plasma emits so much thermal bremsstrahlung that, contrary to previous expectations, the unstable beam-plasma system actually emits more hard X-rays than does the beam in the purely collisional thick target regime relevant to larger injection areas. Inclusion of ion-cyclotron waves results in ion-acoustic wave onset at lower T sub e/T sub i and a marginal stability treatment yields unphysical results. Author

N87-21821*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
ELECTRON-CYCLOTRON MASER EMISSION DURING FLARES: EMISSION IN VARIOUS MODES AND TEMPORAL VARIATIONS
R. M. Winglee and G. A. Dulk (Colorado Univ., Boulder) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 341-346 (For primary document see N87-21785 14-92) (Grants NAGw-78; NAGw-91)
Avail: NTIS HC A21/MF A01 CSCL 03B

Absorption of radiation at the electron-cyclotron frequency, OMEGA sub e, generated by the electron-cyclotron maser instability was proposed as a possible mechanism for transporting energy and heating of the corona during flares. Radiation from the same instability but at harmonics of OMEGA sub e is believed to be the source of solar microwave spike bursts. The actual mode and frequency of the dominant emission from the maser instability is shown to be dependent on: (1) the plasma temperature, (2) the form of the energetic electron distribution, and (3) on the ratio of the plasma frequency omega sub p to OMEGA sub e. As a result, the emission along a flux tube can vary, with emission at harmonics being favored in regions where omega sub p/OMEGA sub e approx. equal to or greater than 1. Changes in the plasma density and temperature in the source region associated with the flare can also cause the characteristics of the emission to change in time. Author

N87-21822*# Saint Andrew's Univ. (Scotland). Dept. of Applied Mathematics.
IMPULSIVELY GENERATED FAST CORONAL PULSATIONS
P. M. Edwin and B. Roberts *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 347-357 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Rapid oscillations in the corona are discussed from a theoretical standpoint, developing some previous work on ducted, fast magnetoacoustic waves in an inhomogeneous medium. In the theory, impulsively (e.g., flare) generated mhd (magnetohydrodynamic) waves are ducted by regions of low Alfven speed (high density) such as coronal loops. Wave propagation in such ducts is strongly dispersive and closely akin to the behavior of Love waves in seismology, Pekeris waves in oceanography and guided waves in fiber optics. Such flare-generated magnetoacoustic waves possess distinctive temporal signatures consisting of periodic, quasi-periodic and decay phases. The quasi-periodic phase possesses the strongest amplitudes and the shortest time scales. Time scales are typically of the order of a second for inhomogeneities (coronal loop width) of 1000 km and Alfven speeds of 1000/kms, and pulse duration times are of tens of seconds. Quasi-periodic signatures have been observed in radio wavelengths for over a decade and more recently by SMM. It is hoped that the theoretical ideas outlined may be successfully related to these observations and thus aid the interpretation of oscillatory signatures recorded by SMM. Such signatures may also provide a diagnostic of coronal conditions. New aspects of the ducted mhd waves, for example their behavior in smoothly varying as opposed to tube-like inhomogeneities, are currently under investigation. The theory is not restricted to loops but applied equally to open field regions. Author

N87-21823*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHOCK ACCELERATION OF ELECTRONS AND IONS IN SOLAR FLARES Abstract Only
Donald C. Ellison (Maryland Univ., College Park) and Reuven Ramaty *In its* Rapid Fluctuations in Solar Flares 1986 p 359 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The simultaneous first-order Fermi shock acceleration of electrons, protons, and alpha particles are compared to observations of solar energetic particle events. For each event, a unique shock compression ratio in the range approx. 1.6 to 3 produces spectra in good agreement with observation. The range in compression ratios predicts that the more than 5 orders of magnitude spread in electron to proton intensity ratios observed at MeV energies is compressed to about 3 orders of magnitude at an assumed injection energy of 100 keV. The remaining spread can be accounted for with a modest range of injection conditions. The model predicts that the acceleration time to a given energy will be approximately equal for electrons and protons and, for reasonable solar parameters, can be on the order of 1 second to approx. 100 MeV. Author

N87-21824*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE GENERATION OF RAPID SOLAR FLARE HARD X-RAY AND MICROWAVE FLUCTUATIONS IN CURRENT SHEETS
Gordon D. Holman *In its* Rapid Fluctuations in Solar Flares 1986 p 361-371 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The generation of rapid fluctuations, or spikes, in hard X-ray and microwave bursts via the disruption of electron heating and acceleration in current sheets is studied. It is found that 20 msec hard X-ray fluctuations can be thermally generated in a current sheet if the resistivity in the sheet is highly anomalous, the plasma density in the emitting region is relatively high, and the volume of the emitting region is greater than that of the current sheet. A specific mechanism for producing the fluctuations, involving heating in the presence of ion acoustic turbulence and a constant driving electric field, and interruption of the heating by a strong two-stream instability, is discussed. Variations upon this mechanism are also discussed. This mechanism also modulates electron acceleration, as required for the microwave spike emission. If the hard X-ray emission at energies less than approx. 1000 keV is nonthermal bremsstrahlung, the coherent modulation of electron acceleration in a large number of current sheets is required.
Author

N87-21825*# Glasgow Univ. (Scotland). Dept. of Astronomy.
THE QUASI-LINEAR RELAXATION OF THICK-TARGET ELECTRON BEAMS IN SOLAR FLARES
K. G. McClements, J. C. Brown, and A. G. Emslie (Alabama Univ., Huntsville) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 373-391 Sponsored in part by SERC and Glasgow Univ., Scotland (For primary document see

N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The effects of quasi-linear interactions on thick-target electron beams in the solar corona are investigated. Coulomb collisions produce regions of positive gradient in electron distributions which are initially monotonic decreasing functions of energy. In the resulting two-stream instability, energy and momentum are transferred from electrons to Langmuir waves and the region of positive slope in the electron distribution is replaced by a plateau. In the corona, the timescale for this quasi-linear relaxation is very short compared to the collision time. It is therefore possible to model the effects of quasi-linear relaxation by replacing any region of positive slop in the distribution by a plateau at each time step, in such a way as to conserve particle number. The X-ray bremsstrahlung and collisional heating rate produced by a relaxed beam are evaluated. Although the analysis is strictly steady state, it is relevant to the theoretical interpretation of hard X-ray bursts with durations of the order of a few seconds (i.e., the majority of such bursts). Author

N87-21826*# New Hampshire Univ., Durham. Space Science Center.
THE PROPAGATION OF SOLAR FLARE PARTICLES IN A CORONAL LOOP
J. M. Ryan *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 383-392 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

A time-dependent diffusion equation with velocity-dependent diffusion and energy-loss coefficients was solved for the case where energetic solar particles are injected into a coronal loop and then diffuse out the ends of the loop into the lower corona/chromosphere. The solution yields for the case of relativistic electrons, precipitation rates and populations which are necessary for calculating thick and thin target X-ray emission. It follows that the thick target emission is necessarily delayed with respect to the particle acceleration on injection by more than the mere travel time of the particle over the loop length. In addition the time-dependent electron population at the top of the loop is calculated. This is useful in estimating the resulting micron-wave emission. The results show relative timing differences in the different emission processes which are functions of particle species, energy and the point of injection of the particles into the loop. Equivalent quantities are calculated for non-relativistic protons. Author

N87-21827*# Toyama Univ. (Japan).
SIGNATURES OF CURRENT LOOP COALESCENCE IN SOLAR FLARES
J. Sakai, H. Nakajima (Tokyo Astronomical Observatory, Japan), E. Zaidman (Texas Univ., Austin), T. Tajima, T. Kosugi (Tokyo Astronomical Observatory, Japan), and F. Brunel (National Research Council of Canada, Ottawa, Ontario) *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 393-434 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The nonlinear coalescence instability of current carrying solar loops can explain many of the characteristics of the solar flares such as their impulsive nature, heating and high energy particle acceleration, amplitude oscillations of electromagnetic emission as well as the characteristics of 2-D microwave images obtained during a solar flare. The physical characteristics of the explosive coalescence of currents are presented in detail through computer simulation and theory. Canonical characteristics of the explosive coalescence are: (1) a large amount of impulsive increase of kinetic energies of electrons and ions; (2) simultaneous heating and acceleration of electrons and ions in high and low energy spectra; (3) ensuing quasi-periodic amplitude oscillations in fields and particle quantities; and (4) the double peak (or triple peak) structure in these profiles, participate in the coalescence process, yielding varieties of phenomena. Author

N87-21828*# Berkeley Research Associates, Inc., Calif.
THERMAL WAVES OR BEAM HEATING IN THE 1980, NOVEMBER 5 FLARE
Dean F. Smith *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 435-443 Prepared in cooperation with Colorado Univ., Boulder (For primary document see N87-21785 14-92)
(Contract NASw-3603; Grant NSF ATM-83-14511)
Avail: NTIS HC A21/MF A01 CSCL 03B

Observations of the temporal evolution of loop BC in soft X rays in the November 5, 1980 flare are reviewed. Calculations are performed to model this evolution. The most consistent interpretation involving a minimum account of energy is the following. Thermal heating near B gives rise to a conduction front which moves out along the loop uninhibited for about 27 s. Beam heating near C gives rise to a second conduction front which moves in the opposite direction and prevents any energy reaching C by thermal conduction from B. Thus both thermal waves and beam heating are required to explain the observed evolution. Author

N87-21829*# National Research Council of Canada, Ottawa (Ontario). Inst. of Astrophysics.
A DOUBLE LAYER MODEL FOR SOLAR X-RAY AND MICROWAVE PULSATIONS
K. F. Tapping *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 445-453 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

The wide range of wavelengths over which quasi-periodic pulsations have been observed suggests that the mechanism causing them acts upon the supply of high energy electrons driving the emission processes. A model is described which is based upon the radial shrinkage of a magnetic flux tube. The concentration of the current, along with the reduction in the number of available charge carriers, can rise to a condition where the current demand exceeds the capacity of the thermal electrons. Driven by the large inductance of the external current circuit, an instability takes place in the tube throat, resulting in the formation of a potential double layer, which then accelerates electrons and ions to MeV energies. The double layer can be unstable, collapsing and reforming repeatedly. The resulting pulsed particle beams give rise to pulsating emission which are observed at radio and X-ray wavelengths. Author

N87-21830*# Thessaloniki Univ. (Greece). Dept. of Physics.
THEORETICAL STUDIES ON RAPID FLUCTUATIONS IN SOLAR FLARES
Loukas Vlahos *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 455-460 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

Rapid fluctuations in the emission of solar bursts may have many different origins e.g., the acceleration process can have a pulsating structure, the propagation of energetic electrons and ions can be interrupted from plasma instabilities and finally the electromagnetic radiation produced by the interaction of electrostatic and electromagnetic waves may have a pulsating behavior in time. In two separate studies the conditions for rapid fluctuations in solar flare driven emission were analyzed. Author

N87-21831*# Nagoya Univ. (Japan). Toyokawa Observatory.
A JAPANESE PLAN: LARGE RADIO HELIOGRAPH IN THE SOLAR MAX NO. 22
Shinzo Enome *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 461-466 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

An outline as of February, 1986 is briefly described of a Japanese plan to construct a large radio heliograph in the next solar maximum. The principal performance specifications of the heliograph are 10 arsec by 10 arcsec x SEC(Zenith Distance) spatial resolution, 1 arc degree by 1 arc degree field of view, 1-sec temporal resolution, and six hour coverage of observing time. It will be operated at 17 GHz with possible other frequency of 35GHz. Author

N87-21832*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE HESP (HIGH ENERGY SOLAR PHYSICS) PROJECT
K. Kai *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 467-478 (For primary document see N87-21785 14-92)
Avail: NTIS HC A21/MF A01 CSCL 03B

A project for space observations of solar flares for the coming solar maximum phase is briefly described. The main objective is to make a comprehensive study of high energy phenomena of flares through simultaneous imagings in both hard and soft X-rays. The project will be performed with collaboration from US scientists. The HESP (High Energy Solar Physics) WG of ISAS (Institute of Space and Astronautical Sciences) has extensively discussed future aspects of space observations of high energy phenomena of solar flares based on successful results of the Hinotori mission, and proposed a comprehensive research program for the next solar maximum, called the HESP (SOLAR-A) project. The objective of the HESP project is to make a comprehensive study of both high energy phenomena of flares and quiet structures including pre-flare states, which have been left uncovered by SMM and Hinotori. For such a study simultaneous imagings with better resolutions in space and time in a wide range of energy will be extremely important. Author

N87-21833*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Astronomy Program.
THE PROPOSED NRAO MILLIMETER ARRAY AND ITS USE FOR SOLAR STUDIES
Mukul R. Kundu *In* NASA. Goddard Space Flight Center Rapid Fluctuations in Solar Flares 1986 p 471-478 (For primary document see N87-21785 14-92)
(Grants NAG5-511; NGR-21-002-199)
Avail: NTIS HC A21/MF A01 CSCL 03B

A brief summary is given of the proposed National Radio Astronomy Observatory (NRAO) Millimeter Array discussed at a workshop held in Green Bank, W. Va., September 30 to October 2, 1985. A brief description of the solar studies that can be made with such an array is provided. Author

N87-21834*# Houseline, Inc., Swarthmore, Pa.
COMPARISON OF LONG-WAVE AND SHORTWAVE IRRADIANCES AT SATELLITE ALTITUDE WITH INTEGRATED SCANNER MEASUREMENTS USING THE NIMBUS 7 ERB DATA SET Final Report
Frederick B. House Aug. 1986 31 p
(NASA Order S-21145-D)
(NASA-CR-177909; NAS 1.26:177909) Avail: NTIS HC A03/MF A01 CSCL 03B

The usefulness of the Earth Radiation Budget (ERB) data set in its present form was studied. Emphasis is placed on the comparison of wide-field-of-view measurements with integrated scanner observations at satellite altitudes. The purpose of making these comparisons is to check for the need of spectral corrections when processing the shortwave scanning radiometer data. B.G.

N87-21835# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SOLAR WIND PLASMA IN THE MAGNETOSPHERE METHOD OF ENTRY AND CONSEQUENCES Final Report, Feb. 1983 - Nov. 1986
W. P. Olson, K. A. Pfitzer, and S. L. Huston Nov. 1986 53 p
(Contract F49620-84-C-0018)
(AD-A177255; MDC-H3136; AFOSR-87-0041TR) Avail: NTIS HC A04/MF A01 CSCL 04/1

Early calculations of magnetopause shape assume that all solar wind particles are specularly reflected off the geomagnetic field. Early work with energetic solar cosmic rays showed that they gain access to the magnetosphere and that the magnetospheric magnetic field exerts considerable influence on their subsequent trajectories. The Lorentz force and trajectories are determined on thousands of solar wind particles impacting on a realistic model of the geomagnetic and electrostatic fields. The magnetosphere can be penetrated by some of the solar wind particles provided that it impacts the magnetopause from the right direction. It is shown qualitatively that the magnetospheric response to this charge entry produces currents that flow in the regions and directions of the observed magnetospheric currents. Also, the response produces electric fields in the same direction and location as observed. Finally, the entry process introduces plasma directly to those regions of the magnetosphere where it is observed to persist, i.e., in the plasma sheet, in the tail, and in the dayside cusps. These results include the effects of the electric field produced by the entering particles. The ultimate goal of this work is the quantitative description of the magnetic and electric fields and particles, and current distributions observed in the magnetopause and boundary layers. GRA

N87-21836# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 506, OCTOBER 1986. PART 2: (COMPREHENSIVE REPORTS). DATA FOR APRIL 1986
Helen E. Coffey, ed. Apr. 1986 34 p
(Contract N00014-86-F-0049)
(PB87-126397; SGD-506-Pt-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A03/MF A01 CSCL 03B

Information addressed included the detailed index for 1986; and the data for April 1986 (Meudon carte synotique, solar flares, solar radio bursts at fixed frequencies, solar X-ray radiation from GOES satellites, mass ejections from the Sun, and active prominences and filaments). GRA

N87-21837# National Center for Atmospheric Research, Boulder, Colo.
WHITE LIGHT SOLAR CORONA: AN ATLAS OF 1985 K-CORONAMETER SYNOPTIC CHARTS, DECEMBER 1984 - DECEMBER 1985
D. G. Sime, C. Garcia, E. Yasukawa, E. Lundin, and K. Rock Oct. 1986 73 p
(Grant NSF-ATM-82-17015)
(PB87-138095; NCAR/TN-274+STR) Avail: NTIS HC A04/MF A01 CSCL 03B

The synoptic observing program of the Mauna Loa Solar Observatory (MLSO) has as its goal the specification of the time-dependent structure of the solar corona. The growth of the low intensity polar regions and ordering of the brighter corona into a band near the equator seen in the second, third, and fourth years of observations (1981 to 1983) continued through 1984. In 1985, the corona remains in the same general form, with the brightest regions concentrated in a band around the equator, similar to the situation noted near the last solar minimum. The apparent excursions of the darkest regions (polar holes) towards the equator seen at the start of the year become less pronounced with time. However, the area embraced by the highest brightness contours tends to increase throughout the year, perhaps indicating that the corona has gone through its minimum configuration. The material presented here is in a format providing a convenient access to investigators intending to make correlation studies or an intercomparison of standard synoptic data sets. GRA

N87-21838*# Stanford Univ., Calif. Center for Space Science and Astrophysics.
ON THE 152-DAY PERIODICITY OF THE SOLAR FLARE OCCURRENCE RATE
Taeil Bai and Peter A. Sturrock Nov. 1986 15 p
(Grant NGL-05-020-272; Contract N00014-85-K-0111)
(NASA-CR-180519; NAS 1.26:180519; AD-A176920; SU-CSSA-Astro-86-39) Avail: NTIS HC A02/MF A01 CSCL 03A

The occurrence rate of solar flares exhibits a periodicity of about 152 days. This periodicity was discovered from analyses of flares observed with the Solar Maximum Mission (SMM), and confirmed with flares observed by other observatories. This periodicity was also discovered from the flare rate of solar cycle 20 (1965 to 1975). The cause of the 152 day periodicity still remains a mystery. But answers to the following questions will

enhance our understanding of it: (1) Is the periodicity a local or global phenomenon? (2) Is the periodicity due to interactions of hot spots rotating at different rates such that they align with one another once in every 152-day period? (3) Is the periodicity due to interactions of rotating features originating from g-mode oscillations? Analyzing major flares observed with the Hard X Ray Burst Spectrometer (HXRBS) aboard SMM concludes that the 152 day periodicity is a global phenomenon. GRA

N87-21839*# Stanford Univ., Calif. Center for Space Science and Astrophysics.
CLASSIFICATION OF SOLAR FLARES AND RELATIONSHIP BETWEEN THE FIRST AND SECOND PHASES
Taeil Bai Aug. 1986 14 p Presented at the 26th COSPAR Solar Maximum Analysis Workshop, Stanford, Calif.
(Grant NGL-05-020-272; Contract N00014-85-K-0111)
(NASA-CR-180221; NAS 1.26:180221; AD-A177012; CSSA-ASTRO-86-37) Avail: NTIS HC A02/MF A01 CSCL 03B

A large solar flare data base obtained during the last solar maximum years makes it necessary to revise views on the relationship between the impulsive and second phase of flares. Contrary to the view held before the launch of the Solar Maximum Mission, it is now known that relativistic electrons and gamma ray producing protons and ions are accelerated during the impulsive phase. Because flares producing nuclear gamma rays are different from ordinary flares, it is concluded that additional processes take place in gamma ray line flares. Recent studies have shown that flares with gradual hard X-ray time profiles not only produce nuclear gamma rays during the impulsive phase but also develop full-fledged second-phase phenomena. Filament interacts with an overlying flare loop, relativistic electrons and energetic protons are produced during the impulsive phase. When the erupting filament fully distends the overlying flare loop, full fledged second phase phenomena, such as shocks, interplanetary energetic particles, mass ejections, etc., are observed. When the overlying flare loop is compact and strong enough to suppress the activated filament, gamma-rays are emitted during the first phase but no second phase phenomena occur. GRA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N87-21840 California Univ., Berkeley.
THE PHYSICAL ORIGINS OF THE COSMIC ULTRAVIOLET BACKGROUND Ph.D. Thesis
Donn Christopher Martin 1986 344 p
Avail: Univ. Microfilms Order No. DA8624855

Two experiments which were performed to determine the origins of the far ultraviolet diffuse background are described. The first experiment was designed to make high sensitivity, moderate resolution spectroscopic measurements in the 600 to 2000 A band. All aspects of the instrument design, including the choice of the optical configuration, diffraction grating, detectors, filters, spectrograph design, and baffling systems were determined by key considerations: maximization of sensitivity and spectral resolution, minimization of biases and noise introduced by stellar contamination, airglow scattering, and internal background. The spectrometer was recently flown on Shuttle mission 61-C and successfully performed nine observations. For the second experiment, a far ultraviolet imaging camera was designed and built to search for small scale fluctuations in the far ultraviolet background that would be the signature of a significant integrated background contribution from normal spiral galaxies. Fluctuations were observed that were correlated for all the systematic errors which can bias a measurement of small amplitude fluctuations. Dissert. Abstr.

N87-21841# Los Alamos National Lab., N. Mex.
A THIRD CLASS OF HIGH ENERGY BURSTER
J. G. Laros, E. E. Fenimore, and R. W. Klebesadel 1986 4 p Presented at the Texas Symposium, Chicago, Ill., 14 Dec. 1986
(Contract W-7405-eng-36)
(DE87-006051; LA-UR-87-358; CONF-861264-1) Avail: NTIS HC A02/MF A01

Until recently, only two cosmic high-energy burster classes (X-ray bursters and gamma-ray bursters (GRBs)) were recognized. However, as early as 1979 it was realized that events similar to GRBs, but which did not fit comfortably into that class, occasionally occurred. This realization arrived in the form of the famous March 5 Event of 1979, which had, among its many unique attributes, typical photon energies of tens of keV - that is, midway between X-ray burster and GRB energies. Subsequently, the source was seen to repeat sporadically about a dozen times, with about one day separating the closest recurrences. Eventually, a few other bursters unlike normal GRBs and possibly related to the March 5 source were found. All had similar average photon energies of tens of keV, and most had durations of tenths of a second. One of them, first seen on March 24, 1979, repeated twice within three days. Unfortunately, this suspected third class of high-energy burster may be one of the least well studied phenomena in astrophysics. This is largely because most of the photons are emitted at awkward energies, in the gap between the regions of coverage provided respectively by most of the X-ray and gamma-ray instrumentation in space. DOE

N87-21842# Iowa State Univ. of Science and Technology, Ames.
VERY HIGH ENERGY GAMMA RAY ASTROPHYSICS Progress Report, 1 May 1986 - 15 Feb. 1987
R. C. Lamb and D. A. Lewis Feb. 1987 11 p
(Contract DE-AC02-80ER-10774)
(DE87-006293; DOE/ER-10774/7) Avail: NTIS HC A02/MF A01

Highlights of research are noted. These include new electronics, noise and gain analysis, tests of imaging, new sources of gamma radiation observed, development of a 37-element mini camera, computer capabilities, and new detector capabilities. DOE

99 GENERAL

N87-21843# Office of Naval Research, London (England).
EUROPEAN SCIENCE NOTES, VOLUME 41, NUMBER 2 Monthly Report
C. J. Fox Feb. 1987 64 p
(AD-A176116; ESN-41-2) Avail: NTIS HC A04/MF A01 CSCL 05/2

European Science Notes is a monthly publication with brief articles on recent developments in European scientific research. Partial contents: The 17th Meeting of the Federation of European Biochemical Societies - Neurobiochemistry; technology; Biotechnology; concurrent computer architecture at Erlangen Univ., West Germany; Suprenum - The West German Supercomputer; Meeting on atmospheric studies by optical methods; British research at Plessey (Caswell) on materials for pyroelectric detectors; Tribiology research at Laboratorie de Technologie des Surfaces; France; European meeting of turbulent drag reduction; Ocean Sciences - European Geophysical Meeting, August 1986; Gas Laser Research at Twente, Netherlands; New trends in the Optoelectronic Research Division of Siemens AG, Neuperlach, West Germany are presented. GRA

N87-21844# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[ACTIVITIES REPORT IN PHYSICS] Annual Report, 1985
Oct. 1986 47 p Original contains color illustrations
(ETN-87-99368) Avail: NTIS HC A03/MF A01

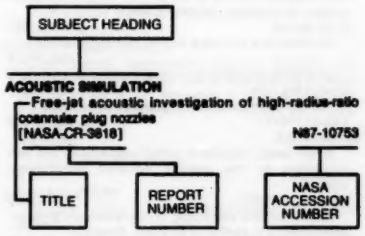
Characterization of nutation dampers for Meteosat; measurements of the impact pressure on a ship's keel; a holographic

system for analyzing objects inaccessible for direct inspection under a microscope; restoring of images degraded by atmospheric turbulence; spectral properties of CO2 at high temperature; extrapolation of the acoustic pressure fields from near field measurements; acoustic analysis in the near field of the laminar-turbulent transition of the boundary layer; propeller noise for high speed aircraft; low frequency acoustic propagation in the vicinity of the ground; application of CARS to resonance in the analysis of minority radicals (detection of OH in a plasma); characterization of lightning strikes on an aircraft in flight; 3D imaging of atmospheric discharges; electromagnetic couplings associated with discharges on aircraft; electrical discharges on insulating surfaces at reduced pressure; and electrostatic discharges on geostationary satellites are discussed. ESA

N87-21845# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Research Center.
[ACTIVITIES REPORT IN AEROSPACE SCIENCES] Annual Report, 1985
Oct. 1986 19 p Original contains color illustrations
(ETN-87-99369) Avail: NTIS HC A02/MF A01

Laminar boundary layers in a hypersonic flow; boundary manipulators; analyses of airfoil laminarity versus Reynolds number in the wind tunnel; real time shop planning; force control robot; multicyclic helicopter blade pitch control (flight performance of the stochastic adaptive regulator); artificial intelligence and software engineering; acoustic intensimetry; radar measurement systems; evaluation of the electrical quality of GaAs field effect transistors; and ceramic composite SiC fiber coatings are discussed. ESA

Typical Subject Index Listing



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A

ABLATION
Layered target burnthrough experiments using 50 nsec KrF laser pulses
[DE87-005111] N87-21329

ABSORPTION COOLING
Ten degree Kelvin hydride refrigerator
[NASA-CASE-NPO-16393-1-CU] N87-21159

ABSORPTION SPECTRA
Infrared absorption and emission characteristics of interstellar PAHs
[NASA-TM-89287] N87-21075
Application of the ALE and MBE methods to the growth of layered Hg sub 1-x Cd sub x Te films
[AD-A176797] N87-21692

ABSTRACTS
Abstracts of papers submitted in 1985 for publication (for Woods Hole Oceanographic Institution)
[PB87-129433] N87-21532
Plasma physics abstracts, 1 January - 31 December, 1986
[NASA-CR-180220] N87-21684

ABUNDANCE
Model ion abundances for comet Halley
[DE87-003710] N87-21783

ACCELERATION (PHYSICS)
Turbulent energy generated by accelerations and shocks
[DE87-002377] N87-21274

ACCELERATION STRESSES (PHYSIOLOGY)
Thresholds of long-latency-period potentials and sensation of motion evoked in man by linear accelerations N87-21571

ACCELERATION TOLERANCE
Thresholds of long-latency-period potentials and sensation of motion evoked in man by linear accelerations N87-21571
Some pathological signs in pelvis minor organs after exposure to long-term high-level +Gz accelerations N87-21577
Centrifuge testing of a G compensated/pressure demand oxygen regulator
[AD-A176117] N87-21587

ACCIDENTS
Behavior of UO2 and fissium in sodium vapor atmosphere at temperatures up to 2600 C — reactor core disassembly
[KFK-4135] N87-21677

ACCURACY
Accuracy of time transfer in satellite systems
[AD-A176579] N87-20984
Precision cutting and drilling with the Nd-YAG laser
[DE87-001359] N87-21317
The absolute measuring accuracy of technical laser interferometers
[ETN-87-99580] N87-21331
Handbook for the Quality Assurance of Meteorological measurements
[PB87-140422] N87-21452

ACETATES
Ice-melting characteristics of calcium magnesium acetate
[PB87-122123] N87-21167

ACETYLENE
Polydiacetylene single crystal fibres and their use in fibre-reinforced composites
[AD-A176927] N87-21049

ACIDS
Change in bile acid and lipid content of human bile during exposure to antiorthostatic hypokinesia and its correction N87-21566

ACOUSTIC ATTENUATION
Acoustic-mean flow interactions
[AD-A176845] N87-21038
Acoustic guide for noise-transmission testing of aircraft
[NASA-CASE-LAR-13111-1-CU] N87-21652

ACOUSTIC DUCTS
Irregular modes in a duct with an impedance wall
[NLR-MP-85066-U] N87-21656

ACOUSTIC EMISSION
Fundamentals of hardening and decohesion behavior in time-dependent cycle deformation
[DE87-003995] N87-21091
Acoustic emission point source locations on thin spherical shell
[DE87-004015] N87-21393
Technical description of an acoustic Doppler based upper ocean profiling system
[PB87-142162] N87-21551

ACOUSTIC IMPEDANCE
Irregular modes in a duct with an impedance wall
[NLR-MP-85066-U] N87-21656

ACOUSTIC LEVITATION
Fiber glass pulling — in space
[NASA-CR-179036] N87-21140

ACOUSTIC MEASUREMENT
Activities report in aerospace sciences
[ETN-87-99369] N87-21845

ACOUSTIC PROPAGATION
Study of an optimum design problem with frequency criteria applied to a structure-fluid coupled system
[ECL-86-06] N87-21396

ACOUSTIC PROPERTIES
Acoustic radiation stress measurement
[NASA-CASE-LAR-13440-1] N87-21653

ACOUSTIC SCATTERING
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
Characteristics of the two-dimensional spectrum of roughness on a seamount
[AD-A176366] N87-21538
Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21546
Test of FORTRAN program for sound scattering by layered sphere
[ARE-TM(UHA)-86518] N87-21654

ACOUSTIC SIMULATION
Calculation of the effect of a point impact on an infinite elastic plate adjacent to a semi-infinite fluid
[NPL-DITC-80/86] N87-21369

ACOUSTIC VELOCITY
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535
A numerical method for solving for normal modes with impedance bottom
[AD-A176591] N87-21540

ACOUSTICS
Activities report in electrical technology
[ETN-87-99354] N87-21253
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655
Activities report in physics
[ETN-87-99366] N87-21844

ACTIVITY (BIOLOGY)
Biological processes in the water column of the south Atlantic bight: Phytoplankton responses
[DE87-003987] N87-21547

ACTUATORS
Advanced Electromechanical Actuation System (EMAS), flight test
[AD-A176148] N87-21001
Modeling and experimental validation of a single-link flexible manipulator
[AD-A176814] N87-21338
The near-minimum time control of a robot arm
[AD-A176875] N87-21339

ADAPTERS
Self indexing latch system
[NASA-CASE-MFS-25956-1] N87-21333

ADAPTIVE CONTROL
State constraints for predictive control with air vehicle application
[AD-A176205] N87-21002
Adaptive finite difference methods in fluid dynamics
[DE87-004890] N87-21266

ADDITIVES
A literature review of the properties and uses of vanadium in engineering alloys and of vanadium carbide
[DE87-900462] N87-21096
Development of a large-scale antimisting kerosene blender
[AD-A176997] N87-21134
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136

ADHESION TESTS
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Part A: Adhesion and delamination
[ETN-87-99576] N87-21056
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination
[ETN-87-99577] N87-21057

ADHESIVE BONDING
Nonlinear viscoelastic analysis of adhesively bonded joints
[AD-A176494] N87-21379

ADRENAL GLAND
Reactivity of adrenosympathetic system and tolerance to exercise load during repeated exposure to stationary magnetic field N87-21573

ADRENAL METABOLISM
Neurohumoral and mechanical factors in the modulation of left ventricular mass
[NASA-CR-180524] N87-21554

AERIAL EXPLOSIONS
The variation of pressure on the ground with height of burst of high explosive charges
[AWRE-O-9/86] N87-21258

AERIAL PHOTOGRAPHY
Rapid search for spherical objects in aerial photographs
[AD-A176391] N87-21406
AERODYNAMIC BALANCE
Experimental determination of the stable-trim attitudes of two proposed, general-purpose, heat-source modules
[NASA-TM-86345] N87-20967
Airplane automatic control force trimming device for asymmetric engine failures
[NASA-CASE-LAR-13260-1] N87-20999
AERODYNAMIC CHARACTERISTICS
Studies in non-linear unsteady aerodynamics
[AD-A177006] N87-20971
La Recherche Aerospatiale, bimonthly bulletin, number 1986-2, 231/March-April
[ESA-TT-998] N87-20974
Prediction of the aerodynamic characteristics of cruciform missiles including effects of roll angle and control deflection
[AD-A176553] N87-21010
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341
Antarctic atmospheric infrasound
[AD-A176804] N87-21434
AERODYNAMIC COEFFICIENTS
Filament wound data base development, revision 1
[NASA-CR-179068-REV-1] N87-21016
AERODYNAMIC CONFIGURATIONS
Experimental determination of the stable-trim attitudes of two proposed, general-purpose, heat-source modules
[NASA-TM-86345] N87-20967
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
Preliminary report on candidates for AGARD standard aeroelastic configurations for dynamic response
[NASA-TM-89142] N87-21376
AERODYNAMIC LOADS
Experimental studies on the dynamic development and control of unsteady separated flows
[AD-A176376] N87-20969
Prediction of the aerodynamic characteristics of cruciform missiles including effects of roll angle and control deflection
[AD-A176553] N87-21010
Summary of the modeling and test correlations of a NASTRAN finite element vibrations model for the AH-1G helicopter, task 1
[NASA-CR-178201] N87-21373
AERODYNAMIC STABILITY
Studies in non-linear unsteady aerodynamics
[AD-A177006] N87-20971
AERODYNAMICS
Aeronautical engineering: A continuing bibliography with indexes (supplement 213)
[NASA-SP-7037(213)] N87-20955
Aeronautical engineering: A cumulative index to a continuing bibliography
[NASA-SP-7037(209)] N87-20956
An approach to practical aerodynamic calculations
[AD-A176995] N87-20970
Activities report in aerodynamics
[ETN-87-99372] N87-20973
On the aerodynamics of flames N87-21058
Activities report in fluid mechanics
[ETN-87-99370] N87-21288
AEROELASTICITY
Development of optimization system OPTSYS: Implementation of static aeroelastic constraints
[FFA-TN-1986-40] N87-20994
Activities report in structures
[ETN-87-99375] N87-21166
Preliminary report on candidates for AGARD standard aeroelastic configurations for dynamic response
[NASA-TM-89142] N87-21376
AERONAUTICAL ENGINEERING
Aeronautical engineering: A continuing bibliography with indexes (supplement 213)
[NASA-SP-7037(213)] N87-20955
Aeronautical engineering: A cumulative index to a continuing bibliography
[NASA-SP-7037(209)] N87-20956
State constraints for predictive control with air vehicle application
[AD-A176205] N87-21002
Flexible and dynamic data model applied in an engineering data management system
[NLR-MP-85011-U] N87-21741
AERONOMY
Activities report in aeronomy
[ETN-87-99366] N87-21442
AEROSOLS
Liquid seeding atomizer
[NASA-CASE-ARC-11631-1] N87-21255
Validation of SAM 2 and SAGE satellite
[NASA-CR-178256] N87-21429
AEROSPACE ENGINEERING
Flexible and dynamic data model applied in an engineering data management system
[NLR-MP-85011-U] N87-21741
AEROSPACE ENVIRONMENTS
Progress toward predicting high-voltage charging of spacecraft in low polar orbit
[AD-A176939] N87-21027
Microgravity Fluid Management Symposium
[NASA-CP-2465] N87-21141
Advanced long term cryogenic storage systems N87-21142
Mixing-induced fluid destratification and ullage condensation N87-21149
Superfluid helium on orbit transfer (SHOOT) N87-21151
Microgravity fluid management in two-phase thermal systems N87-21152
Microgravity fluid management requirements of advanced solar dynamic power systems N87-21153
Two-phase reduced gravity experiments for a space reactor design N87-21154
Activities report in physics
[ETN-87-99368] N87-21844
AEROSPACE INDUSTRY
Superalloy resources: Supply and availability
[NASA-TM-89886] N87-21077
Providing knowledge by means of artificial intelligence techniques: Experiences and developments at the National Aerospace Laboratory (NLR)
[NLR-MP-85061-U] N87-21622
AEROSPACE MEDICINE
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 297)
[NASA-SP-7011(297)] N87-21552
Inception of Soviet system of medical screening of cosmonauts (hospital stage) N87-21559
AEROSPACE SCIENCES
ONERA publications catalog 1986
[ETN-87-99379] N87-21735
AEROSPACE SYSTEMS
Activities report in systems
[ETN-87-99371] N87-20962
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
Effect of manufacturing processes on structural allowables
[AD-A176232] N87-21080
AEROSPACE VEHICLES
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California
[AD-A176509] N87-20958
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
AEROTHERMODYNAMICS
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 1
[NASA-CR-179074] N87-21012
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 3
[NASA-CR-179076] N87-21013
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 2
[NASA-CR-179075] N87-21014
Activities report in aerospace sciences
[ETN-87-99369] N87-21845
AGING (MATERIALS)
Effect of grain boundary structure on sensitization and corrosion of stainless steel
[AD-A176299] N87-21081
AGRICULTURE
Foundations and applications of multispectral scanning in agriculture
[NLR-MP-85015-U] N87-21408
AH-1G HELICOPTER
Summary of the modeling and test correlations of a NASTRAN finite element vibrations model for the AH-1G helicopter, task 1
[NASA-CR-178201] N87-21373
AILERONS
Aileron reversal of swept wings with crossflexibilities
[RAE-TR-83023] N87-20988
Advanced Electromechanical Actuation System (EMAS), flight test
[AD-A176148] N87-21001
AIR COOLING
Noctural topoclimatology
[WCP-117] N87-21520
AIR FLOW
Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor N87-21181
A prediction method for the air-droplets flow in the inlet section of a natural draft cooling tower
[VKI-TM-40] N87-21301
Stratified flow and wave motion near mountain tops N87-21514
Laboratory simulation of rotating stratified flow over and around the Alps N87-21516
Thunderstorm influence on boundary layer winds
[AD-A176543] N87-21518
AIR INTAKES
A new design concept for indraft wind-tunnel inlets with application to the national full-scale aerodynamic complex
[NASA-TM-88226] N87-21006
Acquisition and processing of non-stationary pressure measurments in studies of air intake distortion N87-21191
AIR LAND INTERACTIONS
The aim and conduct of ALPEX — Alpine Experiment (ALPEX) N87-21486
Accuracy of temperature fields and local data sets for the Tatra mountains (Poland) N87-21492
AIR LAW
Extended Range Twin Operations (ETOPS) — twin engined aircraft
[CAP-513] N87-20976
Present and future military uses of outer space: International law, politics, and the practice of states
[AD-A176722] N87-21753
AIR MASSES
Vertical air motion and turbulence parameters from commercial aircraft N87-21494
AIR POLLUTION
Atmospheric transport and dispersion of pollutants and related meteorological studies: Program summary
[DE87-005644] N87-21418
Effective removal parameters in long-range transport models, derived from diffusion theory calculations — air pollution
[ECN-187] N87-21419
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere
[DE87-003600] N87-21438
AIR TRAFFIC CONTROL
Developments in air traffic control systems and their relation with meteorology
[RAE-TRANS-2143] N87-20981
A coordinate conversion algorithm for multisensor data processing
[AD-A176366] N87-21603
AIR TRANSPORTATION
Extended Range Twin Operations (ETOPS) — twin engined aircraft
[CAP-513] N87-20976
AIR WATER INTERACTIONS
The Mediterranean-Alpine Experiment (MED-ALPEX) data set N87-21489
AIRBORNE EQUIPMENT
Meteorological measurements with motor gliders in Poland N87-21488
Development and operation of a measuring data acquisition system for use in light airplanes N87-21497
AIRCRAFT ACCIDENT INVESTIGATION
Aircraft accident reports: Brief format, US civil and foreign aviation, issue number 14, 1985 accidents
[PB88-916926] N87-20980
AIRCRAFT CONSTRUCTION MATERIALS
Activities report in materials
[ETN-87-99374] N87-21054
AIRCRAFT CONTROL
Rotary-wing aircraft terrain-following/terrain-avoidance system development
[NASA-TM-88323] N87-20982
Airplane automatic control force trimming device for asymmetric engine failures
[NASA-CASE-LAR-13260-1] N87-20999
State constraints for predictive control with air vehicle application
[AD-A176205] N87-21002
AIRCRAFT ENGINES
Aircraft and engine development testing
[AD-A176711] N87-20961

Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
Acquisition and processing of non-stationary pressure measurments in studies of air intake distortion N87-21191

AIRCRAFT EQUIPMENT
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Advanced Electromechanical Actuation System (EMAS), flight test
[AD-A176148] N87-21001
Fault tolerant electrical power system. Phase 1: Study
[AD-A177061-PH-1] N87-21246

AIRCRAFT MAINTENANCE
Light aircraft maintenance. General guidance on implementation of the Light Aircraft Maintenance Scheme (LAMS), for aircraft not exceeding 2730 kg MTWA, with a certificate of airworthiness in the transport, aerial work or private category
[CAP-520] N87-20954
Ground de-icing of aircraft
[CAP-512] N87-20975

AIRCRAFT NOISE
Acoustic guide for noise-transmission testing of aircraft
[NASA-CASE-LAR-13111-1-CU] N87-21652

AIRCRAFT PERFORMANCE
Challenges in modeling the X-29 flight test performance
[NASA-TM-88282] N87-20991

AIRCRAFT POWER SUPPLIES
Fault tolerant electrical power system. Phase 1: Study
[AD-A177061-PH-1] N87-21246

AIRCRAFT SAFETY
Ground de-icing of aircraft
[CAP-512] N87-20975

AIRCRAFT STRUCTURES
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California
[AD-A176509] N87-20958
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
Wing divergence and structural distortion
[RAE-TR-85057] N87-20969
Development of optimization system OPTSYS: Implementation of static aeroelastic constraints
[FFA-TN-1986-40] N87-20994
Activities report in structures
[ETN-87-99375] N87-21166

AIRFOILS
An approach to practical aerodynamic calculations
[AD-A176995] N87-20970
Studies in non-linear unsteady aerodynamics
[AD-A177006] N87-20971
Activities report in fluid mechanics
[ETN-87-99370] N87-21288

AIRLINE OPERATIONS
Extended Range Twin Operations (ETOPS) — twin engined aircraft
[CAP-513] N87-20976
Vertical air motion and turbulence parameters from commercial aircraft N87-21494

AIRPORTS
Runway Visual Range (RVR) documentation of the civil airports in the Netherlands
[KNMI-TR-84] N87-20986

ALCOHOLS
Viscosity behavior in supercooled pure liquids and mixtures
[DE87-004036] N87-21282

ALGORITHMS
Algorithm implementation on the Navier-Stokes computer
[NASA-TM-89119] N87-20968
Algorithms used in ARROWS: Autodesign of radio relay optimum wideband systems
[PB87-126405] N87-21229
Compaction with automatic jog introduction
[AD-A176525] N87-21240
A coordinate conversion algorithm for multisensor data processing
[AD-A176368] N87-21603
Cubic Interpolated pseudo-Particle (CIP): A new numerical solver for general nonlinear hyperbolic equations in multidimension
[KFK-4154] N87-21631

ALIPHATIC COMPOUNDS
Prediction of fire properties of materials. Part 1: Aliphatic and aromatic hydrocarbons and related polymers
[PB87-140240] N87-21072

ALKYD RESINS
A handbook of (sup)13 C NMR spectra of alkyd paint binders and associated materials — nuclear magnetic resonance (NMR)
[MQAD-TP-911] N87-21114

ALLOYS
Fracture and hardness of semiconductor alloys
[AD-A176800] N87-21088
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys
[AD-A176970] N87-21089
Effects of irradiation on the fracture toughness of Alloy 718 plate and weld
[DE87-004345] N87-21102

ALPINE METEOROLOGY
The determination of lee circulation during the Foehn wind N87-21465
Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1
[WMO-TD-VOL-1] N87-21485
The aim and conduct of ALPEX — Alpine Experiment (ALPEX) N87-21486
Review of the weather phenomena observed during the Alpine Experiment (ALPEX) special observing period N87-21487
Analysis and quality of Alpine Experiment (ALPEX) data N87-21488
The Mediterranean-Alpine Experiment (MED-ALPEX) data set N87-21489
The quality of the Alpine Experiment (ALPEX) 2b data set with regard to the application of vorticity dynamics N87-21490
A variational objective analysis scheme for analysis of the ALPEX data set — Alpine Experiment (ALPEX) N87-21491
Results of the Alpine Experiment (ALPEX) aircraft intercomparison on 19 April 1982 N87-21493
Meteosat contribution to Alpine Experiment (ALPEX): Highlights and limits N87-21495
Multivariate analyses of ALPEX satellite retrievals — Alpine Experiment (ALPEX) N87-21496
Remotely sensed sea surface temperature for the Alpine Experiment (ALPEX) — AVHRR-2 data N87-21497
Alpine lee cyclogenesis: Numerical simulation and theory N87-21498
A theory of deep cyclogenesis in the lee of the Alps: Modification of baroclinic instability by topography N87-21499
A normal mode nongeostrophic model of lee cyclogenesis N87-21501
Spanish Limited Area Model (LAM) behavior in two cases of Mediterranean cyclogenesis N87-21502
Representation of pressure drag effects in numerical modeling of Alpine cyclogenesis N87-21503
Numerical simulation of lee cyclogenesis during Alpine Experiment with an isentropic coordinate model N87-21504
The role of Alps mountains representation in the lee cyclogenesis simulation N87-21505
Vorticity budgets for Alpine cyclogenesis with and without the forcing of terrain N87-21508
Fine mesh analysis of Genoa cyclogenesis by use of isentropic coordinates N87-21509
Nonalpine contribution to Mediterranean cyclogenesis: Synoptic study of two cases which occurred during Alpine Experiment (ALPEX) Special Observing Period N87-21510
Synoptic 3D energy budgets during Alpine Experiment Special Observing Period (ALPEX-SOP) N87-21511
Comparative study of several cases of Alpine lee-cyclogenesis: Kinetic energy and vorticity N87-21512
Effects of terrain height and blocking initialization on numerical simulation of Alpine lee cyclogenesis N87-21515

ALPS MOUNTAINS (EUROPE)
The role of Alps mountains representation in the lee cyclogenesis simulation N87-21505
Laboratory simulation of rotating stratified flow over and around the Alps N87-21516

ALTIMETERS
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537

ALTITUDE SICKNESS
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness
[AD-A176558] N87-21556

ALUMINUM
Advanced B and Al combustion kinetics studies over wide temperature ranges
[AD-A176828] N87-21061
Aluminum-air battery crystallizer
[DE87-005839] N87-21252
Inertia friction welding of 1100 aluminum to type 316 stainless steel
[DE87-005044] N87-21347
Impact verification of space suit design for space station
[NASA-CR-180456] N87-21584

ALUMINUM ALLOYS
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California
[AD-A176509] N87-20958
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Plasma joining of metal matrix composites
[AD-A176690] N87-21042
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Part A: Adhesion and delamination
[ETN-87-99576] N87-21056
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination
[ETN-87-99577] N87-21057
The corrosion mechanisms for primer coated 2219-T87 aluminum
[NASA-TP-2715] N87-21076
Effect of aluminum addition on ductility and yield strength of Fe3Al alloys with 0.5 wt % TiB2
[DE87-004621] N87-21098

ALUMINUM HYDRIDES
Preparation and characterization of potassium hydroaluminates KAlH4, K3AlH6, K2NaAlH6, K3AlH4F2
[INSA-IDTC1-8602] N87-21057

ALUMINUM OXIDES
Study of ceramic-metal bonding: Application to copper-alumina bonding
[ECL-86-13] N87-21360

AMINES
Rat brain polyamine levels during long-term hypokinesia N87-21580

AMMONIUM PERCHLORATES
Holographic investigation of metallized solid propellant combustion in a three-dimensional motor
[AD-A176140] N87-21131

AMORPHOUS MATERIALS
Investigations into the origins of the physical structure of thin films
[AD-A176943] N87-21117

AMPLIFICATION
The near-minimum time control of a robot arm
[AD-A176875] N87-21339
Elastic interactions of a crack with damage and associated energy release rates
[AD-A177071] N87-21365

AMPLIFIER DESIGN
Low phase noise oscillator using two parallel connected amplifiers
[NASA-CASE-GSC-13018-1] N87-21232

AMPLIFIERS
Low phase noise oscillator using two parallel connected amplifiers
[NASA-CASE-GSC-13018-1] N87-21232
Metal hydride temperature amplifiers for high temperature (260 C) applications: A parametric study
[DE87-005297] N87-21415

ANALOG SIMULATION
Macromodeling of digital circuits
[AD-A176874] N87-21243

ANALYSIS (MATHEMATICS)
Some research problems in reliability theory and in limit theory
[AD-A176439] N87-21363

ANECHOIC CHAMBERS
Evaluation of off-axis measurements performed in an anechoic chamber
[PB87-134367] N87-21658

ANISOTROPY
Field assisted etching
[RSRE-MEMO-3715] N87-21161

Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 2: Manifestations of the mechanisms related to large oriented structures in homogeneous turbulence. Part A: Experimental study. Part B: Theoretical study
[ETN-87-99395] N87-21294
GANTRAS: A system of codes for the solution of the multigroup transport equation with a rigorous treatment of anisotropic neutron scattering. Plane and spherical geometry
[KFK-4163] N87-21665

ANNEALING
Effects of stresses on the phase transformation of NITINOL
[AD-A177053] N87-21090
The effect of ion damage and annealing on superconducting transition metal-nitride compounds
[DE87-005986] N87-21712

ANNIHILATION REACTIONS
Neutral meson decays and the annihilation contribution
[PREPRINT-515] N87-21686
The production of weak intermediate bosons in electron-positron reactions
[PREPRINT-520] N87-21667
Searching for an intermediate mass Higgs boson at large energy e+e-, linear colliders
[PREPRINT-530] N87-21671
Theoretical summary — p pbar
[PREPRINT-532] N87-21730

ANNOTATIONS
Abstracts of papers submitted in 1985 for publication (for Woods Hole Oceanographic Institution)
[PB87-129433] N87-21532

ANNULAR FLOW
Application of Doppler and transit laser anemometry in small turbomachines N87-21180

ANOMALIES
Observations and theory of the AMPTE (Active Magnetospheric Particle Tracer Explorers) magnetotail barium releases
[DE87-006325] N87-21440

ANTARCTIC REGIONS
Antarctic atmospheric infrasound
[AD-A176804] N87-21434

ANTENNA ARRAYS
Phase pattern of phased array element
[AD-A176621] N87-21218
The proposed NRAO millimeter array and its use for solar studies N87-21833

ANTENNA DESIGN
Test methodology for adaptive antenna systems
[AD-A176295] N87-21215

ANTENNA RADIATION PATTERNS
Phase pattern of phased array element
[AD-A176621] N87-21218
Evaluation of off-axis measurements performed in an anechoic chamber
[PB87-134367] N87-21658

ANTENNAS
Measurement apparatus and procedure for the determination of surface emissivities
[NASA-CASE-LAR-13455-1] N87-21206
Test methodology for adaptive antenna systems
[AD-A176295] N87-21215

ANTIMATTER
The gravitational properties of antimatter
[DE87-003967] N87-21725

ANTIMISSILE DEFENSE
Induction linear accelerator technology for SDIO applications
[DE87-003251] N87-21642

ANTIMISTING FUELS
Development of a large-scale antimisting kerosene blender
[AD-A176997] N87-21134

ANTIOXIDANTS
Assessment of remaining lubricant life
[AD-A177186] N87-21121

APERTURES
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217

APPLICATIONS PROGRAMS (COMPUTERS)
The magnetic flux contributed by the plasma armature in an electromagnetic launcher
[MRL-R-1033] N87-21009
The application of Computer Aided Design (CAD) techniques in a route-planning system
[NLR-MP-85039-U] N87-21605
Morphological transformations of binary images
[FOA-30447-3.3] N87-21509
Flexible and dynamic data model applied in an engineering data management system
[NLR-MP-85011-U] N87-21741

APPROACH
The Taguchi approach to quality control and enhancement: A primer
[AD-A176571] N87-21364

APPROACH CONTROL
The Taguchi approach to quality control and enhancement: A primer
[AD-A176571] N87-21364

APPROXIMATION
Data approximation by splines in one and two independent variables
[NPL-DITC-77/86] N87-21623

ARC DISCHARGES
Tetrahydrogen
[AD-A176778] N87-21133

ARC JET ENGINES
The NASA Electric Propulsion Program
[NASA-TM-89856] N87-21037

ARC WELDING
Submerged arc welding of high strength structural steels
[VTT-436] N87-21361

ARCHITECTURE
Failure strengths of laminated glass units
[PB87-118873] N87-21113
Space station group activities habitability module study
[NASA-CR-4010] N87-21585

ARCHITECTURE (COMPUTERS)
Hypercube Applications at Oak Ridge National Laboratory
[DE87-005691] N87-21594
European Science Notes, Volume 41, Number 2
[AD-A176116] N87-21843

ARGON
Report on the calibration of two spinning-rotor gauges for the BIPM very low pressure intercomparison — Bureau International des Poids et Mesures (BIPM)
[NPL-MOM-80] N87-21305

ARGON PLASMA
Nonequilibrium in flowing atmospheric plasmas
[ETN-87-99587] N87-21686

ARMATURES
The magnetic flux contributed by the plasma armature in an electromagnetic launcher
[MRL-R-1033] N87-21009

ARRAYS
Ductile fracture and random versus regular hole/void arrays
[AD-A176627] N87-21085

ARTIFICIAL INTELLIGENCE
Mobile robots in research and development programs at the Savannah River site
[DE87-003114] N87-21352
Contribution to the implementation of dynamic vision in the three-dimensional perception system of the HILARE robot
[CNRS-ORDER-959] N87-21357
Artificial intelligence techniques for working with knowledge
[NLR-MP-85037-U] N87-21621
Providing knowledge by means of artificial intelligence techniques: Experiences and developments at the National Aerospace Laboratory (NLR)
[NLR-MP-85081-U] N87-21622
Multivariate analysis and its applications
[AD-A177019] N87-21637

ARTIFICIAL SATELLITES
Accuracy of time transfer in satellite systems
[AD-A176579] N87-20984
Satellites and developing countries: Purpose, problems, and progress
[AD-A176538] N87-21022
Communication systems through artificial Earth satellites (selected pages)
[AD-A176940] N87-21028

ASSEMBLER ROUTINES
A compiler-compiler for the SCP3 micro-program
[RSRE-MEMO-3982] N87-21592

ASSEMBLING
Task execution control in assembly robot workcells
[LAAS-86-335] N87-21356

ASTEROID BELTS
Collisional evolution in the asteroid belt: An observational and numerical study N87-21768

ASTEROIDS
Research in planetary studies and operation of the Mauna Kea Observatory
[NASA-CR-180513] N87-21763
Collisional evolution in the asteroid belt: An observational and numerical study N87-21768

ASTROMETRY
Ad astra HIPPARCOS. Astronomical mission of the European Space Agency
[ESA-BR-24] N87-21766

ASTRONOMICAL MODELS
Pick-up ion trajectories in a comet model
[AD-A176618] N87-21770
Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares N87-21805

ASTRONOMICAL OBSERVATORIES
The proposed NRAO millimeter array and its use for solar studies N87-21833

ASTRONOMY
The low frequency space array
[AD-A177115] N87-21758
Ad astra HIPPARCOS. ,Astronomical mission of the European Space Agency
[ESA-BR-24] N87-21766

ASTROPHYSICS
The frontiers of physics (the next 25 years)
[DE87-004329] N87-21648
Very high energy gamma ray astrophysics
[DE87-006293] N87-21842

ASYMPTOTIC METHODS
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384
On a new Darboux transformation for the construction of exact solutions of the Schroedinger equation
[PREPRINT-523] N87-21634

ATLANTIC OCEAN
Quick look Atlantic Ocean rain maps for gale
[NASA-CR-180511] N87-21533
Tidal estimation in the Atlantic and Indian Oceans, 3 deg x 3 deg solution
[NASA-TM-87812] N87-21534

ATMOSPHERIC ATTENUATION
Computational model for the simulation of millimeter-wave propagation through the clear atmosphere
[PB87-131173] N87-21209
Model results with PIIE (Polar Ionospheric Irregularities Experiment) rocket data
[AD-A176999] N87-21436

ATMOSPHERIC BOUNDARY LAYER
Case studies for flux measurements along a low-flying route to the south of Munich N87-21459
Measurements of the vertical structure of the convective boundary layer N87-21461
Aircraft measurements during the Bonn Experiment (BONEX 1) — atmospheric boundary layer N87-21463
The atmospheric boundary layers
[KNMI-TR-89] N87-21524

ATMOSPHERIC CHEMISTRY
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere
[DE87-003600] N87-21438

ATMOSPHERIC CIRCULATION
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
A numerical investigation of an orogenic mesoscale convective system N87-21425
The determination of lee circulation during the Foehn wind N87-21465
Proceedings of the International Conference on the Results of the Global Weather Experiment and Their Implications for the World Weather Watch, Volume 1
[WMO-TD-107-VOL-1] N87-21470
The observational objectives and the implementation of the Global Weather Experiment N87-21474
Global diagnostic studies based on data collected during the Global Experiment — Global Weather Experiment N87-21483
Diagnostic research into the tropical atmosphere and the role of tropical processes in the general circulation N87-21484
The quality of the Alpine Experiment (ALPEX) 2b data set with regard to the application of vorticity dynamics N87-21490
Quasi-Lagrangian diagnostics of a Mediterranean cyclone: Isentropic results N87-21507
Vorticity budgets for Alpine cyclogenesis with and without the forcing of terrain N87-21508
Comparative study of several cases of Alpine lee-cyclogenesis: Kinetic energy and vorticity N87-21512
Weather regimes and mountain effects in general circulation models: Implications for extended range weather forecasts N87-21513
Biosphere-Atmosphere Transfer Scheme (BATS) for the NCAR (National Center for Atmospheric Research) community climate model
[PB87-141511] N87-21530
Wind forcing experiments in the California current system
[AD-A176818] N87-21545

ATMOSPHERIC COMPOSITION
Retrievals of lower stratospheric ozone profiles from Nimbus-4 and their use in a synoptic-climatological study N87-21423
Retarding potential analyzer research [NASA-CR-180508] N87-21427
Validation of SAM 2 and SAGE satellite [NASA-CR-178256] N87-21429
Haute-Provence (France) observatory lidar station, summary and outlook (1981-1986) [ETN-87-99365] N87-21441
Activities report in aeronomy [ETN-87-99366] N87-21442
Ultraviolet observations of Jupiter and Uranus N87-21762

ATMOSPHERIC DIFFUSION
Effective removal parameters in long-range transport models, derived from diffusion theory calculations — air pollution [ECN-187] N87-21419

ATMOSPHERIC ENTRY
A theoretical examination of a reentry capsule incorporating an autorotating rotor [AD-A176854] N87-21026

ATMOSPHERIC HEAT BUDGET
Motor glider measurements during the urban atmosphere energy budget experiment (EESA 1) N87-21464
Global diagnostic studies based on data collected during the Global Experiment — Global Weather Experiment N87-21483
Synoptic 3D energy budgets during Alpine Experiment Special Observing Period (ALPEX-SOP) N87-21511

ATMOSPHERIC HEATING
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810

ATMOSPHERIC MODELS
Retrieval of moving waves from polar orbiting satellite data N87-21404
Effective removal parameters in long-range transport models, derived from diffusion theory calculations — air pollution [ECN-187] N87-21419
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
A numerical investigation of an orogenic mesoscale convective system N87-21425
Retarding potential analyzer research [NASA-CR-180508] N87-21427
Three dimensional dynamical and chemical modelling of the upper atmosphere [NASA-CR-180514] N87-21428
Development of techniques for the use of DMSP (Defense Meteorology Satellite Program) SSIE (Topside Ionospheric Plasma Monitor) data in the AWS (Air Weather Service) 4D ionosphere model [AD-A176412] N87-21430
Model results with PIIE (Polar Ionospheric Irregularities Experiment) rocket data [AD-A176999] N87-21436
Haute-Provence (France) observatory lidar station, summary and outlook (1981-1986) [ETN-87-99365] N87-21441
Activities report in aeronomy [ETN-87-99366] N87-21442
Alpine lee cyclogenesis: Numerical simulation and theory N87-21498
Spanish Limited Area Model (LAM) behavior in two cases of Mediterranean cyclogenesis N87-21502
Representation of pressure drag effects in numerical modeling of Alpine cyclogenesis N87-21503
Numerical simulation of lee cyclogenesis during Alpine Experiment with an isentropic coordinate model N87-21504
The role of Alps mountains representation in the lee cyclogenesis simulation N87-21505
Synoptic 3D energy budgets during Alpine Experiment Special Observing Period (ALPEX-SOP) N87-21511
Weather regimes and mountain effects in general circulation models: Implications for extended range weather forecasts N87-21513
Thunderstorm influence on boundary layer winds [AD-A176543] N87-21518
The atmospheric boundary layers [KNMI-TR-89] N87-21524
Biosphere-Atmosphere Transfer Scheme (BATS) for the NCAR (National Center for Atmospheric Research) community climate model [PB87-141511] N87-21530
Versatile three-dimensional Hamiltonian ray-tracing program for acoustic waves in the atmosphere above irregular terrain [PB87-115804] N87-21659
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810

ATMOSPHERIC PHYSICS
Proceedings of the Meteorological Motor Glider (MEMO) Workshop [ESA-TT-945] N87-21453
Environmental-physical measurements and determination of atmospheric turbulence with the ASK-16 motor glider N87-21460

ATMOSPHERIC PRESSURE
Spanish Limited Area Model (LAM) behavior in two cases of Mediterranean cyclogenesis N87-21502
Representation of pressure drag effects in numerical modeling of Alpine cyclogenesis N87-21503
Spectral signatures from short-pulse microwave air breakdown [DE87-006116] N87-21686

ATMOSPHERIC SOUNDING
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder [AD-A176578] N87-21432
Spread F: The Scandinavian scene [UIO-SR-86-02] N87-21443
Navigational Aid (NAVAID) vertical sounding system — atmospheric sounding N87-21479
Ship-borne systems for observing wind in the tropical zone N87-21480

ATMOSPHERIC STRATIFICATION
Aircraft measurements during the Bonn Experiment (BONEX 1) — atmospheric boundary layer N87-21463

ATMOSPHERIC TEMPERATURE
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
Accuracy of temperature fields and local data sets for the Tatra mountains (Poland) N87-21492
Tethered balloon measurements made at Naval Air Development Center (December 1985) [AD-A176254] N87-21517

ATMOSPHERIC TURBULENCE
Environmental-physical measurements and determination of atmospheric turbulence with the ASK-16 motor glider N87-21460
Measurements of the vertical structure of the convective boundary layer N87-21461
Vertical air motion and turbulence parameters from commercial aircraft N87-21494

ATMOSPHERICS
Results and analysis of static and dynamic multipath in a severe atmospheric environment [PB87-131165] N87-21231

ATOMIC BEAMS
Variable energy, high flux, ground-state atomic oxygen source [NASA-CASE-NPO-16640-1-CU] N87-21661

ATOMIC INTERACTIONS
Physics at the laser-atomic frontier [PB87-126611] N87-21646

ATOMIC PHYSICS
Physics at the laser-atomic frontier [PB87-126611] N87-21646

ATOMIZERS
Liquid seeding atomizer [NASA-CASE-ARC-11631-1] N87-21255

ATTACHMENT
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer [NASA-CR-4052] N87-21257

ATTENUATION
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen) [AD-A176289] N87-21535

ATTITUDE (INCLINATION)
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms [AD-A176218] N87-20983

AUGMENTATION
The Taguchi approach to quality control and enhancement: A primer [AD-A176571] N87-21384

AURORAL IONIZATION
Model results with PIIE (Polar Ionospheric Irregularities Experiment) rocket data [AD-A176999] N87-21436

AURORAL IRRADIATION
Average configuration of the quiet auroral oval [DMI-GEOPHYS-PAPERS-R-73] N87-21446

AURORAL SPECTROSCOPY
Average configuration of the quiet auroral oval [DMI-GEOPHYS-PAPERS-R-73] N87-21446

AURORAS
Investigation of precipitating electrons during an auroral breakup [KGI-PREPRINT-096] N87-21444
Average configuration of the quiet auroral oval [DMI-GEOPHYS-PAPERS-R-73] N87-21446

AUSTENITIC STAINLESS STEELS
Design of low carbon dual-phase steels for high strength wire [DE87-006169] N87-21104

AUTOMATIC CONTROL
Rotary-wing aircraft terrain-following/terrain-avoidance system development [NASA-TM-88323] N87-20982
Airplane automatic control force trimming device for asymmetric engine failures [NASA-CASE-LAR-13280-1] N87-20999
State constraints for predictive control with air vehicle application [AD-A176205] N87-21002
Algorithms used in ARROWS: Autodesign of radio relay optimum wideband systems [PB87-126405] N87-21229
Self indexing latch system [NASA-CASE-MFS-25956-1] N87-21333
Programmers workbench handbook [PB87-126942] N87-21611
Automation strategy for a Royal Netherlands Air Force (RNLAF) air base command and control information system [NLR-MP-85070] N87-21743
Handbook for operation and maintenance of an NBS (National Bureau of Standards) multisensor automated EM (electromagnetic) field measurement system [PB87-140729] N87-21749

AUTOMATIC WEATHER STATIONS
Automatic mobile platforms — meteorological buoys N87-21477

AUTONOMOUS NAVIGATION
Advanced manipulation for autonomous mobile robots [DE87-002818] N87-21351
Mobile robots in research and development programs at the Savannah River site [DE87-003114] N87-21352

AUTONOMY
Intelligent operating systems for autonomous robots: Real-time capabilities on a hypercube super-computer [DE87-004076] N87-21620

AUTOREGRESSIVE PROCESSES
Analysis and restitution of voice signals using evolving models [ENST-86E009] N87-21226

AUTOROTATION
A theoretical examination of a reentry capsule incorporating an autorotating rotor [AD-A176854] N87-21026

AVIONICS
Fault-tolerant system analysis: Imperfect switching and maintenance [AD-A176514] N87-20995
Reliability growth prediction [AD-A176128] N87-21362

AXIAL FLOW PUMPS
Dual motion valve with single motion input [NASA-CASE-MFS-28058-1] N87-21332

AXIAL LOADS
The comet Giacobini-Zinner magnetotail: Axial stresses and inferred near-nucleus properties [DE87-003712] N87-21775

AXIAL STRAIN
Convergence of strain energy release rate components for edge-delaminated composite laminates [NASA-TM-89135] N87-21377

B

B STARS
Pulsations of B stars: A review of observations and theories [DE87-003717] N87-21776

BACKGROUND NOISE
The physical origins of the cosmic ultraviolet background N87-21640

BACKWARD WAVE TUBES
Millimeter wave generation by relativistic electron beams [AD-A176949] N87-21245

BALL BEARINGS
Performance test of 110 mm bore ball bearing made from corrosion resistant powdered steel [AD-A177060] N87-21342

BALLISTICS
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder [AD-A176297] N87-21262

BALLOON SOUNDING
Operations handbook-ozone measurements to 40-km altitude with Model 4A Electrochemical Concentration Cell (ECC) ozonesonses (used with 1680-MHz radiosondes) [PB87-113874] N87-21426
Aircraft measurements during the Bonn Experiment (BONEX 1) — atmospheric boundary layer N87-21483
Tethered balloon measurements made at Naval Air Development Center (December 1985) [AD-A176254] N87-21517
BALLOON-BORNE INSTRUMENTS
LORAN-C tetroon transponder and tracking system [PB87-116667] N87-20987
BAROCLINIC INSTABILITY
A theory of deep cyclogenesis in the lee of the Alps: Modification of baroclinic instability by topography N87-21499
The mechanisms of orographic cyclogenesis N87-21500
A normal mode nongeostrophic model of lee cyclogenesis N87-21501
BARS
Design of dual phase steels for bars and rods [DE87-003535] N87-21093
BATHYMETERS
Characteristics of the two-dimensional spectrum of roughness on a seamount [AD-A176366] N87-21536
BATHYTHERMOGRAPHS
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA21, 7-20 July 1986 [AD-A176636] N87-21541
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986 [AD-A176639] N87-21542
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986 [AD-A176795] N87-21544
BAYS (STRUCTURAL UNITS)
Shuttle middeck fluid transfer experiment: Lessons learned N87-21158
BAYS (TOPOGRAPHIC FEATURES)
Biological processes in the water column of the south Atlantic bight: Phytoplankton responses [DE87-003987] N87-21547
BEAM INTERACTIONS
The acceptance of the SSC (Superconducting Supercollider) clustered lattice [DE87-004177] N87-21697
BEAMS (RADIATION)
Beam-modulation methods in quantitative and flow-visualization holographic interferometry N87-21204
BENDING
Nonlinear viscoelastic analysis of adhesively bonded joints [AD-A176494] N87-21379
BERYLLIUM
Titanium-beryllium residual strain analysis: Role of deposition variables on texture and strength [DE87-006197] N87-21106
BETATRONS
The acceptance of the SSC (Superconducting Supercollider) clustered lattice [DE87-004177] N87-21697
Determination of the linear aperture of the SSC (Superconducting Supercollider) clustered lattice used for the conceptual design report [DE87-004179] N87-21698
BIBLIOGRAPHIES
Aeronautical engineering: A continuing bibliography with indexes (supplement 213) [NASA-SP-7037(213)] N87-20955
Aeronautical engineering: A cumulative index to a continuing bibliography [NASA-SP-7037(209)] N87-20956
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 297) [NASA-SP-7011(297)] N87-21552
ONERA publications catalog 1986 [ETN-87-99379] N87-21735
BINARY ALLOYS
Oxidation behavior of chromium and a chromium-yttrium binary alloy [DE87-003772] N87-21095
BINARY STARS
Dynamical evolution of spherical stellar systems N87-21767
Relativistic (3+1) dimensional hydrodynamic simulations of compact interacting binary systems [DE87-000602] N87-21771
White dwarf models of supernovae and cataclysmic variables [DE87-004172] N87-21773
BINDERS (MATERIALS)
A handbook of (sup)13 C NMR spectra of alkyd paint binders and associated materials — nuclear magnetic resonance (NMR) [MQAD-TP-911] N87-21114
BIOASSAY
Morphological and biochemical analysis of some rat organs and tissues following exposure to 1.1 and 2.0 G gravity N87-21569
BIOCHEMISTRY
Biological materials for integrated circuits [RSRE-MEMO-3965] N87-21237
Morphological and biochemical analysis of some rat organs and tissues following exposure to 1.1 and 2.0 G gravity N87-21569
European Science Notes, Volume 41, Number 2 [AD-A176116] N87-21843
BIOELECTRICITY
Bioelectrical activity of the heart and blood electrolytes in essentially healthy subjects submitted to antiorthostatic hypokinesia for 120 days N87-21563
BIOLOGICAL EFFECTS
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 297) [NASA-SP-7011(297)] N87-21552
Direct and indirect effects of stationary magnetic field on biological systems N87-21574
BIOSPHERE
Biosphere-Atmosphere Transfer Scheme (BATS) for the NCAR (National Center for Atmospheric Research) community climate model [PB87-141511] N87-21530
BIOSYNTHESIS
Rat brain polyamine levels during long-term hypokinesia N87-21580
BIOTECHNOLOGY
Biological materials for integrated circuits [RSRE-MEMO-3965] N87-21237
European Science Notes, Volume 41, Number 2 [AD-A176116] N87-21843
BLADE TIPS
Compressor blade clearance measurement using capacitance and phase lock techniques N87-21200
Transonic compressor blade tip flow visualization on a water table [AD-A176592] N87-21265
BLADES
A NASTRAN primer for the analysis of rotating flexible blades [NASA-TM-88661] N87-21375
BLAST LOADS
The variation of pressure on the ground with height of burst of high explosive charges [AWRE-O-9/86] N87-21258
BLOOD
Bioelectrical activity of the heart and blood electrolytes in essentially healthy subjects submitted to antiorthostatic hypokinesia for 120 days N87-21563
BLOOD CIRCULATION
Effect of altered circulation on human nystagmic reactions N87-21570
Some pathological signs in pelvis minor organs after exposure to long-term high-level +Gz accelerations N87-21577
Mechanism of action of local negative pressure applied to human body on dynamics of central circulation N87-21579
BLOOD PRESSURE
Some pathological signs in pelvis minor organs after exposure to long-term high-level +Gz accelerations N87-21577
BLOOD VOLUME
Some pathological signs in pelvis minor organs after exposure to long-term high-level +Gz accelerations N87-21577
BLUNT BODIES
Experimental determination of the stable-trim attitudes of two proposed, general-purpose, heat-source modules [NASA-TM-88345] N87-20967
A spatial marching technique for the inviscid blunt body problem [DE87-004526] N87-20972
BONDING
Method for forming hermetic seals [NASA-CASE-NPO-16423-1-CU] N87-21334
BONE MINERAL CONTENT
Quantitative study of osteoblasts and osteoclasts of rat bones with simulation of weightlessness N87-21566
BOOLEAN FUNCTIONS
On learning boolean functions [AD-A176516] N87-21626
BOOSTER ROCKET ENGINES
Filament wound data base development, revision 1 [NASA-CR-179068-REV-1] N87-21016
BORON
Advanced B and Al combustion kinetics studies over wide temperature ranges [AD-A176828] N87-21061
BORON FLUORIDES
Kinetics of some gas phase elementary reactions of boron monofluoride [AD-A167690] N87-21062
BOSONS
The production of weak intermediate bosons in electron-positron reactions [PREPRINT-520] N87-21667
Massless Higgs boson in softly broken supersymmetric theories [PREPRINT-528] N87-21669
Status of the electroweak theory [PREPRINT-529] N87-21670
Searching for an intermediate mass Higgs boson at large energy e+e-, linear colliders [PREPRINT-530] N87-21671
Heavy Higgs production at future colliders [PREPRINT-531] N87-21672
Gauge fixing for the field theory of the baeonic string [PREPRINT-527] N87-21729
Theoretical summary — p pbar [PREPRINT-532] N87-21730
BOUNDARIES
Rapid search for spherical objects in aerial photographs [AD-A176391] N87-21406
BOUNDARY LAYER EQUATIONS
An approach to practical aerodynamic calculations [AD-A176995] N87-20970
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions [NASA-CR-180272] N87-21303
BOUNDARY LAYER FLOW
In-flight surface oil-flow photographs with comparisons to pressure distribution and boundary-layer data [NASA-TP-2395] N87-20966
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer [NASA-CR-4052] N87-21257
BOUNDARY LAYER SEPARATION
Experimental studies on the dynamic development and control of unsteady separated flows [AD-A176376] N87-20969
An approach to practical aerodynamic calculations [AD-A176995] N87-20970
Studies in non-linear unsteady aerodynamics [AD-A177006] N87-20971
Modeling the interactions shock wave/turbulent boundary layer. Comparison of model with experiment [ECL-86-16] N87-21291
BOUNDARY LAYER TRANSITION
Wavevector-frequency spectrum of transition zone wall pressure fluctuations [AD-A176655] N87-21268
Wake interaction effects on the transition process on turbine blades [AD-A177064] N87-21272
BOUNDARY LAYERS
Thunderstorm influence on boundary layer winds [AD-A176543] N87-21518
BOUNDARY VALUE PROBLEMS
Numerical boundary conditions with minimal reflection for limited-area models [KNMI-WR-86-3] N87-21292
The influence of the wall boundary condition on a solution of the incompressible Navier-Stokes equation [VKI-TM-42] N87-21298
Three dimensional dynamical and chemical modelling of the upper atmosphere [NASA-CR-180514] N87-21428
Four-dimensional data assimilation — numerical weather forecasting N87-21461
Assessment of results from different analysis schemes — GARP N87-21462
BOW WAVES
Plasma physics abstracts, 1 January - 31 December, 1986 [NASA-CR-180220] N87-21684
BRAIN
Rat brain polyamine levels during long-term hypokinesia N87-21580
FY86 independent research/independent exploratory development [AD-A176944] N87-21589
BREMSSTRAHLUNG
Sub-second variations of high energy (300 keV) hard X-ray emission from solar flares N87-21787
BRIGHTNESS TEMPERATURE
Extremely rapid radio spikes in flares: A review N87-21798

BRILLOUIN EFFECT
A microscopic theory for the Brillouin intensities evaluation in noble gas crystals
[PREPRINT-521] N87-21721
Evaluation of Brillouin scattering intensities from rare gas crystals. Part 1: A pure dipole induced dipole theory
[PREPRINT-535] N87-21722
BROADBAND
Algorithms used in ARROWS: Autodesign of radio relay optimum wideband systems
[PB87-126405] N87-21229
Nonlinear optics with broad-band lasers
[DE87-004306] N87-21319
BROADCASTING
VHF radio broadcasting: Propagation and diversity reception of mixed polarised signals over a sea path
[BBC-RD-1987/2] N87-21206
Ground-wave analysis model for MF broadcast systems
[PB87-124293] N87-21228
BROKEN SYMMETRY
Massless Higgs boson in softly broken supersymmetric theories
[PREPRINT-528] N87-21669
Heavy Higgs production at future colliders
[PREPRINT-531] N87-21672
BROMIDES
Vectorial electron transfer on designed surfaces
[PB87-144325] N87-21137
BROMINE
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Vectorial electron transfer on designed surfaces
[PB87-144325] N87-21137
BUBBLES
Vorticity generation by shock propagation through bubbles in air
[AD-A176610] N87-21286
BUNDLES
Composite service life prediction via fiber bundle testing. Evaluation of testing equipment and data acquisition system
[AD-A176835] N87-21365
BUOYANCY
Numerical simulation of buoyant convection in vented enclosures
[DE86-012941] N87-21280
BUOYS
Automatic mobile platforms — meteorological buoys N87-21477
BURNING RATE
A solid propellant charge design with negative effective pressure exponent using forced cone burning
[WSRL-0469-TR] N87-21130
BURNOUT
Comparison between calculated and measured forward and reverse current-voltage characteristics
[AD-A176607] N87-21241
BURNTHROUGH (FAILURE)
Layered target burnthrough experiments using 50 nsec KrF laser pulses
[DE87-005111] N87-21329

C

CALCIUM COMPOUNDS
Ice-melting characteristics of calcium magnesium acetate
[PB87-122123] N87-21167
CALCIUM METABOLISM
Possibility of pharmacological correction of regional osteoporosis in nonbearing extremity N87-21568
CALCULUS OF VARIATIONS
Maximum principle for viscous fluids flowing through regions of pure fluid and mixtures
[DE86-780543] N87-21277
A variational objective analysis scheme for analysis of the ALPEX data set — Alpine Experiment (ALPEX) N87-21491
CALIBRATING
Fluxgate magnetometer analysis and simulation software for the Combined Release and Radiation Effects Satellite (CRRES)
[AD-A176353] N87-21032
A theoretical study of calibration procedures for coherent and non-coherent polarimetric radars
[RSRE-86011] N87-21210
A calibrtion procedure for a coherent polarimetric radar
[RSRE-MEMO-3869] N87-21211
Report on the calibration of two spinning-rotor gauges for the BIPM very low pressure intercomparison — Bureau International des Poids et Mesures (BIPM)
[NPL-MOM-80] N87-21305
Application of a high-precision universal measuring machine in Standards Laboratory measurements
[DE87-003036] N87-21308
The improvement and evaluation of a laser interferometer for the absolute measurement of ultrasonic displacements in the frequency range up to 15 MHz — hydrophones
[NPL-AC-109] N87-21311
The absolute measuring accuracy of technical laser interferometers
[ETN-87-99580] N87-21331
Journal of Research of the National Bureau of Standards, Volume 91, Number 4, July-August 1986
[PB87-109864] N87-21649
CALIFORNIA
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986
[AD-A176795] N87-21544
Wind forcing experiments in the California current system
[AD-A176816] N87-21545
CAMERAS
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
CANONICAL FORMS
Structure theories and applications of multivariable control systems described by block canonical forms
[AD-A176482] N87-21615
CANS
Ductile iron data base. Correlations between microstructure and fracture toughness: Background document for draft ASTM ductile iron specification
[DE87-006010] N87-21107
CAPACITANCE
Compressor blade clearance measurement using capacitance and phase lock techniques N87-21200
CAPILLARY FLOW
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE87-004004] N87-21065
CARBOHYDRATES
Hydrolysis, transport and utilization of carbohydrates in rats with restricted motor activity N87-21567
CARBON
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Traveling-wave-tube efficiency improvement by a low-cost technique for deposition of carbon on multistage depressed collector
[NASA-TP-2719] N87-21239
CARBON DIOXIDE LASERS
Laser evaporation studies
[AD-A176826] N87-21313
CARBON DIOXIDE TENSION
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness
[AD-A176558] N87-21556
CARBON FIBER REINFORCED PLASTICS
Multi-axial failure criteria in fiber composites and their application to the through-thickness strength of hybrid fiber laminates N87-21040
A comparison of the fatigue performance of woven and non-woven CFRP laminates
[RAE-TR-85059] N87-21041
The micromechanics of damage initiation and development under static and fatique loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99985] N87-21044
The effects of impact damage in tapered-thickness CFRP laminates
[RAE-TR-85087] N87-21045
Preimpregnated T5A-145-12-F584 carbon/epoxy from Hexcel-Genin: Elementary characterization
[PV-M5-517700] N87-21126
CARBON FIBERS
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
Ultimate tensile strength of pitch-based carbon fibers
[AD-A176955] N87-21118
CARBON MONOXIDE
Astronomical observations of the 807 GHz CO J = 7.6 rotational line with a new heterodyne spectrometer N87-21759
A CO survey of the dark nebulae in Taurus and Perseus N87-21760
CARBON STEELS
Design of dual phase steels for bars and rods
[DE87-003535] N87-21093
CARBON-CARBON COMPOSITES
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
CARBONACEOUS MATERIALS
Assessment of ceramic composites for multimegawatt space nuclear power systems
[DE87-005272] N87-21675
CARBONATES
Corrosion resistant materials in MCFC environment
[DE87-004199] N87-21414
CARDIAC VENTRICLES
Neurohumoral and mechanical factors in the modulation of left ventricular mass
[NASA-CR-180524] N87-21554
CARDIOLOGY
Neurohumoral and mechanical factors in the modulation of left ventricular mass
[NASA-CR-180524] N87-21554
CARRIER INJECTION
Contribution to understanding and modeling hot carrier injection phenomena in submicron MOS devices
[ECL-86-12] N87-21717
CASCADE FLOW
Numerical grid generations for cascades with and without solution-adaption N87-20963
A new design concept for indraft wind-tunnel inlets with application to the national full-scale aerodynamic complex
[NASA-TM-88226] N87-21006
Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility N87-21183
A study of passage flow through a cascade of turbine blades using image plane holographic interferometry N87-21203
Transonic compressor blade tip flow visualization on a water table
[AD-A176592] N87-21265
Wake interaction effects on the transition process on turbine blades
[AD-A177094] N87-21272
CASCADE WIND TUNNELS
A new design concept for indraft wind-tunnel inlets with application to the national full-scale aerodynamic complex
[NASA-TM-88226] N87-21006
CASUALTIES
Mariners weather log, volume 30, number 4, Fall 1986
[PB87-129417] N87-21526
CATACLYSMIC VARIABLES
White dwarf models of supernovae and cataclysmic variables
[DE87-004172] N87-21773
CATALOGS (PUBLICATIONS)
ONERA publications catalog 1986
[ETN-87-99379] N87-21735
Publications of the National Bureau of Standards, 1985 catalog
[PB87-145272] N87-21751
CATALYSIS
The electrocatalysts of dioxygen reduction on transition metal chelates
[ETN-87-99584] N87-21070
CATECHOLAMINE
Reaction of sympathectomied rat opioid system to immobilization stress N87-21581
CATHODE RAY TUBES
Computer aided design of magnetic deflection systems
[ETN-87-99583] N87-21608
CAVITATION FLOW
Creep cavitation in a nickel aluminide
[DE87-004392] N87-21106
CAVITY RESONATORS
Performance of two coupled lasers
[AD-A177185] N87-21312
Original improvements of the TLM method
[RAE-TRANS-2151] N87-21624
CENTRIFUGES
Centrifuge testing of a G compensated/pressure demand oxygen regulator
[AD-A176117] N87-21587
CENTRIFUGING STRESS
Morphological and biochemical analysis of some rat organs and tissues following exposure to 1.1 and 2.0 G gravity N87-21569
CERAMIC BONDING
Study of ceramic-metal bonding: Application to copper-alumina bonding
[ECL-86-13] N87-21360

CERAMIC COATINGS
Introduction and status of the ceramic technology for advanced heat engines project
[DE87-004403] N87-21122
Fusion technology projects
[ECN-185] N87-21689

CERAMIC MATRIX COMPOSITES
Introduction and status of the ceramic technology for advanced heat engines project
[DE87-004403] N87-21122
Activities report in aerospace sciences
[ETN-87-99369] N87-21845

CERAMICS
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
Performance analysis of advanced spacecraft TPS
[NASA-CR-180496] N87-21011
Development of nuclear magnetic resonance imaging techniques for characterizing green-state ceramic materials
[DE87-004967] N87-21123
New structural materials technologies: Opportunities for the use of advanced ceramics and composites
[PB87-118253] N87-21128
Ultrasonic NDE of green-state ceramic using focused through-transmission
[DE87-001494] N87-21367
Assessment of ceramic composites for multimegawatt space nuclear power systems
[DE87-005272] N87-21675

CEREBRUM
Evaluation of functional state of pilots on the basis of interhemispheric asymmetry N87-21561

CERIUM
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099

CERTIFICATION
Light aircraft maintenance. General guidance on implementation of the Light Aircraft Maintenance Scheme (LAMS), for aircraft not exceeding 2730 kg MTWA, with a certificate of airworthiness in the transport, aerial work or private category
[CAP-520] N87-20954

CHANNEL FLOW
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 3: Spectral manifestations of inhomogeneity due to field effects and to the presence of walls
[ETN-87-99396] N87-21295

CHANNELS (DATA TRANSMISSION)
Communications using channels formed by meteor bursts
[AD-A176094] N87-21222

CHAOS
Intermittency as multifractality in history space
[PREPRINT-518] N87-21639
The abandoned ways: Turbulence and chaos
[NOTA-INTERNA-869] N87-21732

CHARACTERIZATION
Preimpregnated T5A-145-12-F584 carbon/epoxy from Hexcel-Genin: Elementary characterization
[PV-M5-517700] N87-21126

CHARGE EFFICIENCY
Design and development of a multi-kilowatt hour hydrogen/nickel oxide battery
[DE87-006774] N87-21250

CHARGE TRANSFER
Space-charge-induced breakdown in dielectrics
[AD-A176069] N87-21029

CHARGED PARTICLES
Observations and theory of the AMPTE (Active Magnetospheric Particle Tracer Explorers) magnetotail barium releases
[DE87-006325] N87-21440

CHARPY IMPACT TEST
Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels
[DE87-004000] N87-21092

CHELATES
The electrocatalysis of dioxygen reduction on transition metal chelates
[ETN-87-99584] N87-21070

CHEMICAL ANALYSIS
Determination of chloride in hydraulic fluids
[AD-A176406] N87-21060
Gravimetric technique for the preparation of accurate trace organic gas standards
[PB87-145736] N87-21074
Analysis of plasma-nitrided steels
[NASA-TM-89815] N87-21078

CHEMICAL COMPOSITION
Determination of chloride in hydraulic fluids
[AD-A176406] N87-21060
Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels
[DE87-004000] N87-21092
Grain boundary composition effects on environmentally induced cracking of engineering materials
[DE87-006405] N87-21105
Microstructural investigation of copolymers. A key in revealing relations between polymerization conditions and polymer properties
[ETN-87-99585] N87-21127
Accurate measurements of combustion species concentrations using CARS N87-21173

CHEMICAL EXPLOSIONS
The variation of pressure on the ground with height of burst of high explosive charges
[AWRE-O-9/86] N87-21258

CHEMICAL REACTIONS
Preparation and characterization of potassium hydroaluminates KAlH4, K3AlH6, K2NaAlH6, K3AlH4F2
[INSA-IDTC1-8602] N87-21067
Numerical simulation of turbulent reactive flows
[ETN-87-99398] N87-21289
Derivation of working equations of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte with consideration of extracted oxygen N87-21575
EXAFS studies of grain boundary diffusion and segregation
[DE87-003435] N87-21702

CHESAPEAKE BAY (US)
Marine environmental assessment: Chesapeake Bay, December 1985 - February 1986
[PB87-129458] N87-21531
Chesapeake Bay circulation survey: 1981-1983
[PB87-138194] N87-21549

CHIPS (ELECTRONICS)
Methods for thinning silicon chips
[RSRE-MEMO-3952] N87-21162

CHLORIDES
Determination of chloride in hydraulic fluids
[AD-A176406] N87-21060

CHLORINE
Advanced B and Al combustion kinetics studies over wide temperature ranges
[AD-A176828] N87-21061

CHLOROCARBONS
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere
[DE87-003600] N87-21438

CHROMIUM
Oxidation behavior of chromium and a chromium-yttrium binary alloy
[DE87-003772] N87-21095

CHROMIUM ALLOYS
Oxidation behavior of chromium and a chromium-yttrium binary alloy
[DE87-003772] N87-21095

CHROMIUM STEELS
Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels
[DE87-004000] N87-21092

CHROMOSPHERE
Fast fluctuations of soft X-rays from active regions N87-21797

CIRCUITS
Compaction with automatic jog introduction
[AD-A176525] N87-21240

CIRCULAR CYLINDERS
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217
Stability of the vortex motion in oscillating flow
[AD-A176629] N87-21267

CITIES
Motor glider measurements during the urban atmosphere energy budget experiment (EESA 1) N87-21464

CIVIL AVIATION
Aircraft accident reports: Brief format, US civil and foreign aviation, issue number 14, 1985 accidents
[PB86-916928] N87-20960

CLASSIFICATIONS
Using bar code technology to enhance classified document accountability
[DE87-000760] N87-21739
Classification of solar flares and relationship between the first and second phases
[NASA-CR-180221] N87-21839

CLEARANCES
Tip clearance measurement in modern compressor components N87-21199
Compressor blade clearance measurement using capacitance and phase lock techniques N87-21200

CLIMATE
Atmospheric climate data: Problems and promises
[NASA-CR-180442] N87-21450
Noctural topoclimatology
[WCP-117] N87-21520

CLIMATOLOGY
Geophysical Fluid Dynamics Laboratory activities FY86, plans FY87
[PB87-134458] N87-21403
Retrievals of lower stratospheric ozone profiles from Nimbus-4 and their use in a synoptic-climatological study N87-21423
Haze climate of the United States
[PB87-141057] N87-21529
Biosphere-Atmosphere Transfer Scheme (BATS) for the NCAR (National Center for Atmospheric Research) community climate model
[PB87-141511] N87-21530

CLINICAL MEDICINE
Inception of Soviet system of medical screening of cosmonauts (hospital stage) N87-21559

CLOSURES
An investigation of the closure conditions for two-fluid models of two-phase flow
[DE87-004792] N87-21287

CLOUD PHYSICS
Thunderstorm influence on boundary layer winds
[AD-A176543] N87-21518
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519

CMOS
Analysis of the feasibility of silicon on insulator submicron CMOS technology
[ECL-86-07] N87-21716

COAL GASIFICATION
Materials for large land-based gas turbines
[PB87-120531] N87-20998

COASTAL CURRENTS
Chesapeake Bay circulation survey: 1981-1983
[PB87-138194] N87-21549

COATINGS
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Investigations into the origins of the physical structure of thin films
[AD-A176943] N87-21117

CODING
Computer code for gas-liquid two-phase vortex motions: GLVM
[NASA-CR-180265] N87-21139
Using bar code technology to enhance classified document accountability
[DE87-000760] N87-21739
Using vision systems when bar code won't work
[DE87-004514] N87-21740

COEFFICIENTS
Ellipsoidal corrections to potential coefficients obtained from gravity anomaly data on the ellipsoid
[AD-A176901] N87-21435

COGNITION
FY86 independent research/independent exploratory development
[AD-A176944] N87-21589

COHERENT RADAR
A theoretical study of calibration procedures for coherent and non-coherent polarimetric radars
[RSRE-86011] N87-21210
A calibrtion procedure for a coherent polarimetric radar
[RSRE-MEMO-3889] N87-21211

COHERENT RADIATION
Liquid-core fiber optics: Transmission and nonlinear effects
[DE87-005960] N87-21683

COLD PLASMAS
Pick-up ion trajectories in a comet model
[AD-A176618] N87-21770

COLLISIONAL PLASMAS
A study of the propagation of ULF electromagnetic fields in collisional, inhomogeneous, magnetized plasmas
[DE87-004768] N87-21223
COLLISIONS
Collisional evolution in the asteroid belt: An observational and numerical study N87-21766
COLOR
Electronic display equipment for use in the advanced flight deck simulator at British Aerospace, Weybridge
[RID-1912] N87-21005
The 2-4 semiconductor superlattices
[AD-A177092] N87-21696
COLOR VISION
FY86 independent research/independent exploratory development
[AD-A176944] N87-21589
COMBUSTIBLE FLOW
On the modelling of non-reactive and reactive turbulent combustor flows
[NASA-CR-4041] N87-20996
COMBUSTION
On the aerodynamics of flames N87-21058
Numerical simulation of turbulent reactive flows
[ETN-87-99398] N87-21289
Layered target burnthrough experiments using 50 nsec KrF laser pulses
[DE87-005111] N87-21329
COMBUSTION CHAMBERS
Investigation of the characteristics of liquid fuel burning, Rijke type, pulsating combustors
[DE87-001931] N87-21063
CARS thermometry for low and high pressure combustion systems N87-21172
Velocity and temperature measurements in a can-type gas-turbine combustor N87-21184
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
Processing techniques for correlation of LDA and thermocouple signals N87-21194
COMBUSTION EFFICIENCY
Diesel engine combustion program at the Defence Research Establishment Ottawa
[AD-A176436] N87-21336
COMBUSTION PHYSICS
Advanced B and Al combustion kinetics studies over wide temperature ranges
[AD-A176826] N87-21061
Size and shape of solid fuel diffusion flames in very low speed flows
[NASA-CR-179576] N87-21129
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
The study of combustion by means of diode laser spectroscopy N87-21201
COMBUSTION PRODUCTS
Prediction of fire properties of materials. Part 1: Aliphatic and aromatic hydrocarbons and related polymers
[PB87-140240] N87-21072
Supercritical fluid chromatography of polar organic compounds in combustion particulates
[PB87-126845] N87-21073
Comparison of the toxicity of the combustion products from a flexible polyurethane foam and a polyester fabric evaluated separately and together by the NBS (National Bureau of Standards) toxicity test method and a cone radiant heater toxicity test apparatus
[PB87-140265] N87-21169
COMET HEADS
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
COMET TAILS
The comet Giacobini-Zinner magnetotail: Axial stresses and inferred near-nucleus properties
[DE87-003712] N87-21775
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784
COMETS
Research in planetary studies and operation of the Mauna Kea Observatory
[NASA-CR-180513] N87-21763
Pick-up ion trajectories in a comet model
[AD-A176618] N87-21770
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784
COMMAND AND CONTROL
Automation strategy for a Royal Netherlands Air Force (RNLAF) air base command and control information system
[NLR-MP-85070] N87-21743
COMMITTEE ON SPACE RESEARCH
COSPAR's contribution to the early planning of the global observing system of the Global Weather Experiment N87-21473
COMMUNICATION EQUIPMENT
Communication systems through artificial Earth satellites (selected pages)
[AD-A176940] N87-21028
COMMUNICATION NETWORKS
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
The fundamentals of timing and synchronization for digital communication networks
[AD-A176721] N87-21220
Ground-wave analysis model for MF broadcast systems
[PB87-124293] N87-21226
COMMUNICATION SATELLITES
Satellites and developing countries: Purpose, problems, and progress
[AD-A176536] N87-21022
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023
Communication systems through artificial Earth satellites (selected pages)
[AD-A176940] N87-21028
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 1: Executive summary
[NASA-CR-179597-VOL-1] N87-21212
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 2: Technical report
[NASA-CR-179597-VOL-2] N87-21213
COMPACTING
Compaction with automatic jog introduction
[AD-A176525] N87-21240
COMPARATORS
Comparator with noise suppression
[NASA-CASE-LAR-13151-1] N87-21235
COMPARISON
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039
Comparison of the toxicity of the combustion products from a flexible polyurethane foam and a polyester fabric evaluated separately and together by the NBS (National Bureau of Standards) toxicity test method and a cone radiant heater toxicity test apparatus
[PB87-140265] N87-21169
Manipulator Comparative Testing Program
[DE87-008026] N87-21355
COMPATIBILITY
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136
COMPILERS
A compiler-compiler for the SCP3 micro-program
[RSRE-MEMO-3982] N87-21592
Ten 15: An overview — abstract machine
[RSRE-MEMO-3977] N87-21599
COMPLEX SYSTEMS
Efficient methods for evaluating the effects of stressful electromagnetic environments on complex systems
[DE86-006030] N87-21224
COMPONENT RELIABILITY
Acoustic guide for noise-transmission testing of aircraft
[NASA-CASE-LAR-13111-1-CU] N87-21652
COMPOSITE MATERIALS
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 4, Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
Defect and damage characterization in composite materials
[AD-A176335] N87-21047
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
Development of alumina- and mullite-SiC whisker composites: High temperature properties
[DE87-004624] N87-21052
New structural materials technologies: Opportunities for the use of advanced ceramics and composites
[PB87-118253] N87-21128
Thermomechanical effects in inelastic materials and structures
[AD-A177076] N87-21366
Assessment of ceramic composites for multimegawatt space nuclear power systems
[DE87-005272] N87-21675
COMPOSITE STRUCTURES
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 4, Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
La Recherche Aerospatiale, bimonthly bulletin, number 1986-2, 231/March-April
[ESA-TT-998] N87-20974
Composite service life prediction via fiber bundle testing. Evaluation of testing equipment and data acquisition system
[AD-A176835] N87-21365
Identification of material constants for a composite shell structure
[DE87-004524] N87-21395
COMPRESSIBILITY
Compressive properties and laser absorptivity of unidirectional metal matrix composites
[AD-A176194] N87-21046
COMPRESSIBLE FLOW
Toward the large-eddy simulations of compressible turbulent flows
[NASA-CR-178273] N87-21259
Numerical simulation of compressible Navier-Stokes flow in a double throat nozzle
[AD-A177023] N87-21271
COMPRESSION LOADS
Fatigue crack growth under cyclic compression: Role of first load cycle
[FFA-TN-1986-71] N87-21398
COMPRESSION TESTS
Compressive properties and laser absorptivity of unidirectional metal matrix composites
[AD-A176194] N87-21046
COMPRESSIVE STRENGTH
Compressive properties and laser absorptivity of unidirectional metal matrix composites
[AD-A176194] N87-21046
Fabrication of open cell epoxy foam
[DE87-006186] N87-21125
COMPRESSOR BLADES
Vibration analysis by speckle interferometry N87-21197
Tip clearance measurement in modern compressor components N87-21199
Transonic compressor blade tip flow visualization on a water table
[AD-A176592] N87-21265
COMPRESSOR ROTORS
Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor N87-21181
COMPRESSORS
Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor N87-21181
Tip clearance measurement in modern compressor components N87-21199
Compressor blade clearance measurement using capacitance and phase lock techniques N87-21200
Multicomponent flow compressor: A new concept for efficient energy conversion
[DE87-004011] N87-21276
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341
COMPUTATION
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262
Nonlinear viscoelastic analysis of adhesively bonded joints
[AD-A176494] N87-21379
The representation of the Earth's gravitational potential in a spherical harmonic expansion to degree 250
[AD-A176479] N87-21431
A coordinate conversion algorithm for multisensor data processing
[AD-A176368] N87-21603
COMPUTATIONAL FLUID DYNAMICS
Activities report in aerodynamics
[ETN-87-99372] N87-20973
Adaptive finite difference methods in fluid dynamics
[DE87-004890] N87-21286
Numerical simulation of turbulent reactive flows
[ETN-87-99398] N87-21289

Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 2: Manifestations of the mechanisms related to large oriented structures in homogeneous turbulence. Part A: Experimental study. Part B: Theoretical study
[ETN-87-99395] N87-21294
A prediction method for the air-droplets flow in the inlet section of a natural draft cooling tower
[VKI-TM-40] N87-21301
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341

COMPUTATIONAL GRIDS
Numerical grid generations for cascades with and without solution-adaption N87-20963
Toward the large-eddy simulations of compressible turbulent flows
[NASA-CR-178273] N87-21259
Numerical simulation of compressible Navier-Stokes flow in a double throat nozzle
[AD-A177023] N87-21271
Adaptive finite difference methods in fluid dynamics
[DE87-004890] N87-21296
Three dimensional numerical simulations of the UPS-292-SC engine
[DE87-001968] N87-21344
Tidal estimation in the Atlantic and Indian Oceans, 3 deg x 3 deg solution
[NASA-TM-87812] N87-21534

COMPUTER AIDED DESIGN
Development of optimization system OPTSYS: Implementation of static aeroelastic constraints
[FFA-TN-1986-40] N87-20994
Towards an object oriented satellite test environment
[ETN-87-99476] N87-21031
Tabulated output from ELLA — hardware design and description language (ELLA)
[RSRE-MEMO-3966] N87-21602
The application of Computer Aided Design (CAD) techniques in a route-planning system
[NLR-MP-85039-U] N87-21605
Introduction to the development of automation plans for Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) in mechanical engineering
[NLR-MP-85042-U] N87-21606
Computer aided design of magnetic deflection systems
[ETN-87-99583] N87-21608

COMPUTER AIDED MANUFACTURING
Development of a telerobotic system for handling contaminated process equipment
[DE87-004186] N87-21346
Introduction to the development of automation plans for Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) in mechanical engineering
[NLR-MP-85042-U] N87-21606
Programmers workbench handbook
[PB87-120942] N87-21611

COMPUTER AIDED MAPPING
REGIS: An RAE experimental image-based geographic information system
[RAE-TR-84103] N87-21405
The application of Computer Aided Design (CAD) techniques in a route-planning system
[NLR-MP-85039-U] N87-21605

COMPUTER GRAPHICS
The X window system
[AD-A176476] N87-21604
NILFIT: An interactive system for nonlinear fit of data
[HMI-B431] N87-21607
Computer generation of convergent beam electron diffraction patterns — crystallingraphy
[ETN-87-99578] N87-21719

COMPUTER NETWORKS
Algorithm implementation on the Navier-Stokes computer
[NASA-TM-89119] N87-20968

COMPUTER PROGRAM INTEGRITY
Integrity and the Flex programming support environment
[RSRE-MEMO-3915] N87-21601

COMPUTER PROGRAMMING
Development of techniques for the use of DMSP (Defense Meteorology Satellite Program) SSIE (Topside Ionospheric Plasma Monitor) data in the AWS (Air Weather Service) 4D ionosphere model
[AD-A176412] N87-21430
Programmers workbench handbook
[PB87-120942] N87-21611
Artificial intelligence techniques for working with knowledge
[NLR-MP-85037-U] N87-21621

COMPUTER PROGRAMS
Fluxgate magnetometer analysis and simulation software for the Combined Release and Radiation Effects Satellite (CRRES)
[AD-A176353] N87-21032
Implementation of three speckle reduction filters for solid propellant combustion holograms
[AD-A176563] N87-21132
Computer code for gas-liquid two-phase vortex motions: GLVM
[NASA-CR-180265] N87-21139
Results and analysis of static and dynamic multipath in a severe atmospheric environment
[PB87-131165] N87-21231
Computer-aided analysis of two-dimensional laminar and turbulent incompressible flows N87-21256
Vortex motion in a stratified medium
[AD-A176729] N87-21269
STARPAC: The standard times series and regression package
[PB87-152385] N87-21641

COMPUTER STORAGE DEVICES
Cluster beam studies
[AD-A176803] N87-21163

COMPUTER SYSTEMS DESIGN
Agenda for improved evaluation of supercomputer performance
[PB87-137196] N87-21596
Introduction to MASCOT 3
[ARE-TM(UDP)-86102] N87-21598
An evaluation of the Flex programming support environment
[RSRE-86003] N87-21600
Tabulated output from ELLA — hardware design and description language (ELLA)
[RSRE-MEMO-3966] N87-21602
Management of automation projects that are relevant for the Royal Dutch Meteorological Institute (KNMI)
[NLR-MP-85075-U] N87-21734

COMPUTER SYSTEMS PROGRAMS
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985
Calculation of the effect of a point impact on an infinite elastic plate adjacent to a semi-infinite fluid
[NPL-DITC-80/86] N87-21389
A modeling and simulation tool for fault-tolerant distributed systems applied to distributed database management systems
[KFK-4136] N87-21614
Test of FORTRAN program for sound scattering by layered sphere
[ARE-TM(UHA)-86518] N87-21654
GANTRAS: A system of codes for the solution of the multigroup transport equation with a rigorous treatment of anisotropic neutron scattering. Plane and spherical geometry
[KFK-4163] N87-21665

COMPUTER TECHNIQUES
Fault-tolerant system analysis: Imperfect switching and maintenance
[AD-A176514] N87-20995
Rapid search for spherical objects in aerial photographs
[AD-A176391] N87-21406
FY86 independent research/independent exploratory development
[AD-A176944] N87-21589
Real time programming of a robot
[AD-A176762] N87-21616

COMPUTER VISION
Automatic shape parameterisation in machine vision
[NPL-DITC-79/86] N87-21597
Activities report of the Information Systems Department
[FOA-C-30441-3.3] N87-21745

COMPUTERIZED SIMULATION
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
Fluxgate magnetometer analysis and simulation software for the Combined Release and Radiation Effects Satellite (CRRES)
[AD-A176353] N87-21032
Computational model for the simulation of millimeter-wave propagation through the clear atmosphere
[PB87-131173] N87-21209
Macromodeling of digital circuits
[AD-A176874] N87-21243
Numerical simulation of buoyant convection in vented enclosures
[DE86-012941] N87-21280
Shock wave interaction with turbulence: Pseudospectral simulations
[DE87-004357] N87-21281
Modeling and experimental validation of a single-link flexible manipulator
[AD-A176614] N87-21336
The near-minimum time control of a robot arm
[AD-A176875] N87-21339
Three dimensional numerical simulations of the UPS-292-SC engine
[DE87-001968] N87-21344
Advanced manipulation for autonomous mobile robots
[DE87-002818] N87-21351
Computer modeling of high intensity solar cells
[DE87-005970] N87-21416
A numerical investigation of an orogenic mesoscale convective system N87-21425
A modeling and simulation tool for fault-tolerant distributed systems applied to distributed database management systems
[KFK-4136] N87-21614
Real time programming of a robot
[AD-A176762] N87-21616
Intelligent operating systems for autonomous robots: Real-time capabilities on a hypercube super-computer
[DE87-004076] N87-21620
The acceptance of the SSC (Superconducting Supercollider) clustered lattice
[DE87-004177] N87-21697
Computer simulation of special grain boundaries in metals and ionic materials
[DE87-004989] N87-21707
Grain-boundary modeling
[DE87-004737] N87-21710
Relativistic (3+1) dimensional hydrodynamic simulations of compact interacting binary systems
[DE87-000802] N87-21771
Model ion abundances for comet Halley
[DE87-003710] N87-21783
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810

CONCENTRATION (COMPOSITION)
Accurate measurements of combustion species concentrations using CARS N87-21173

CONCENTRATORS
Operations handbook-ozone measurements to 40-km altitude with Model 4A Electrochemical Concentration Cell (ECC) ozonesonses (used with 1680-MHz radiosondes)
[PB87-113874] N87-21426

CONDENSATION
Mixing-induced fluid destratification and ullage condensation N87-21149

CONDENSATION PUMPS
Pool type liquid helium cryopump
[DE87-701268] N87-21349

CONDENSING
Saturation effects in coupled lasers with homogeneous gain
[AD-A176843] N87-21314

CONFERENCES
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California
[AD-A176509] N87-20958
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[AD-A176510] N87-20959
Microgravity Fluid Management Symposium
[NASA-CP-2465] N87-21141
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
Papers presented at a Workshop on Electric Energy Systems Research
[PB87-137238] N87-21254
Gravitation waves. Proceedings of the conference on design of gravitational wave radiator and detector
[DE87-780075] N87-21439
Proceedings of the Meteorological Motor Glider (MEMO) Workshop
[ESA-TT-945] N87-21453
Proceedings of the International Conference on the Results of the Global Weather Experiment and Their Implications for the World Weather Watch, Volume 1
[WMO-TD-107-VOL-1] N87-21470
Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1
[WMO-TD-VOL-1] N87-21485
Rapid Fluctuations in Solar Flares
[NASA-CP-2449] N87-21765

CONFIGURATION MANAGEMENT
Management of automation projects that are relevant for the Royal Dutch Meteorological Institute (KNMI)
[NLR-MP-85075-U] N87-21734
CONNECTORS
The relevance of connectance on the Lyapunov characteristic exponents of products of symplectic random matrices
[PREPRINT-519] N87-21643
CONSERVATION EQUATIONS
Three-dimensional numerical studies of the physics of semiconductor crystal growth
[AD-A176606] N87-21693
CONSTRUCTION MATERIALS
New structural materials technologies: Opportunities for the use of advanced ceramics and composites
[PB87-118253] N87-21128
CONTAINERLESS MELTS
Quasi-containerless glass formation method and apparatus
[NASA-CASE-MFS-28090-1] N87-21111
Fiber glass pulling — in space
[NASA-CR-179036] N87-21140
CONTAMINANTS
Atmospheric transport and dispersion of pollutants and related meteorological studies: Program summary
[DE87-005644] N87-21418
CONTAMINATION
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039
Techniques to determine particulates in liquid fuels
[DE87-002028] N87-21135
CONTINUOUS RADIATION
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536
CONTINUOUS WAVE LASERS
Experimental and theoretical studies of laser propulsion phenomenology
[AD-A176851] N87-21315
Short wavelength laser/materials interactions
[AD-A176950] N87-21316
CONTINUUM MECHANICS
Modeling and control of flexible structures
[AD-A177106] N87-21388
CONTOUR SENSORS
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
CONTROL EQUIPMENT
Introduction to the Z80 didactic assembly
[NOTA-INTERNA-870] N87-21595
CONTROL SURFACES
Experimental studies on the dynamic development and control of unsteady separated flows
[AD-A176378] N87-20969
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
CONTROL SYSTEMS DESIGN
Development of a telerobotic system for handling contaminated process equipment
[DE87-004186] N87-21346
Task execution control in assembly robot workcells
[LAAS-86-335] N87-21356
Quantitative Feedback Theory (QFT): Technique for designing multivariable control systems
[AD-A176883] N87-21617
Activities report in aerospace sciences
[ETN-87-99369] N87-21845
CONTROL THEORY
Wing divergence and structural distortion
[RAE-TR-85057] N87-20989
State constraints for predictive control with air vehicle application
[AD-A176205] N87-21002
OPUS: Optimal Projection for Uncertain Systems
[AD-A176820] N87-21025
Modeling and control of flexible structures
[AD-A177106] N87-21388
Structure theories and applications of multivariable control systems described by block canonical forms
[AD-A176482] N87-21615
Quantitative Feedback Theory (QFT): Technique for designing multivariable control systems
[AD-A176883] N87-21617
CONTROL VALVES
Dual motion valve with single motion input
[NASA-CASE-MFS-28058-1] N87-21332
CONTROLLERS
A real-time expert system for control of an autonomous mobile robot and for diagnosing unexpected occurrences
[DE87-002411] N87-21345
Real-time expert system for control of an autonomous mobile robot including diagnosis of unexpected occurrences
[DE87-000385] N87-21354
CONVECTION
Convectively driven superfluid turbulence in dilute solutions of He3 in superfluid He4
[DE87-002918] N87-21275
Numerical simulation of buoyant convection in vented enclosures
[DE86-012941] N87-21280
Convective scale interaction: Arc cloud lines and the development and evolution of deep convection
N87-21424
A numerical investigation of an orogenic mesoscale convective system N87-21425
Vorticity budgets for Alpine cyclogenesis with and without the forcing of terrain N87-21508
CONVECTION CURRENTS
Measurements of the vertical structure of the convective boundary layer N87-21461
CONVECTIVE HEAT TRANSFER
A correlation for the heat transfer coefficient in a rectangular passage containing protuberance
[AD-A176111] N87-21261
Heat transfer in oscillatory flow
[DE87-004374] N87-21276
Modeling the convection-radiation coupling in porous materials and identification of their radiation characteristics: Application to glass wools
[INSA-86-ISAL-0007] N87-21290
CONVOLUTION INTEGRALS
A class of integral transforms and associated function spaces
[ETN-87-99575] N87-21629
COOLANTS
Superfluid helium on orbit transfer (SHOOT)
N87-21151
COOLING SYSTEMS
A prediction method for the air-droplets flow in the inlet section of a natural draft cooling tower
[VKI-TM-40] N87-21301
COORDINATE TRANSFORMATIONS
The Universal Transverse Mercator grid formulas for cartographic applications programmers
[AD-A176624] N87-21407
COORDINATES
Wave-mode coordinates and scattering matrices for wave propagation
[AD-A176998] N87-21030
Acoustic emission point source locations on thin spherical shell
[DE87-004015] N87-21393
COPOLYMERS
Microstructural investigation of copolymers. A key in revealing relations between polymerization conditions and polymer properties
[ETN-87-99585] N87-21127
COPPER
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
Traveling-wave-tube efficiency improvement by a low-cost technique for deposition of carbon on multistage depressed collector
[NASA-TP-2719] N87-21239
Study of ceramic-metal bonding: Application to copper-alumina bonding
[ECL-86-13] N87-21360
COPPER ALLOYS
Fundamentals of hardening and decohesion behavior in time-dependent cycle deformation
[DE87-003995] N87-21091
CORES
A solid propellant charge design with negative effective pressure exponent using forced cone burning
[WSRL-0469-TR] N87-21130
CORONAL LOOPS
Interpretation of rapid rises in hard X-rays and microwaves with the thermal conduction front model
N87-21788
Fast fluctuations of soft X-rays from active regions
N87-21797
The propagation of solar flare particles in a coronal loop N87-21826
Signatures of current loop coalescence in solar flares
N87-21827
Thermal waves or beam heating in the 1980, November 5 flare N87-21828
CORRECTION
Improvement of fatigue life prediction accuracy for various realistic loading spectra by use of correction factors
[TAE-581] N87-21374
Ellipsoidal corrections to potential coefficients obtained from gravity anomaly data on the ellipsoid
[AD-A176901] N87-21435
SC correction coils and magnets for the HERA proton ring
[NIKHEF-H/86-10] N87-21676
CORRELATION
Study of the free oscillations of the Earth based on gravitional antenna data
[NOTA-INTERNA-868] N87-21447
CORROSION
Determination of chloride in hydraulic fluids
[AD-A176406] N87-21060
Effect of grain boundary structure on sensitization and corrosion of stainless steel
[AD-A176299] N87-21061
CORROSION PREVENTION
Inhibition of localized corrosion
[AD-A176573] N87-21063
CORROSION RESISTANCE
The corrosion mechanisms for primer coated 2219-T87 aluminum
[NASA-TP-2715] N87-21076
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys
[AD-A176970] N87-21089
Performance test of 110 mm bore ball bearing made from corrosion resistant powdered steel
[AD-A177060] N87-21342
Corrosion resistant materials in MCFC environment
[DE87-004199] N87-21414
COSMIC DUST
A CO survey of the dark nebulae in Taurus and Perseus N87-21780
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
COSMIC RAYS
Cosmic ray effects on microelectronics. Part 4
[AD-A176611] N87-21242
Very high energy gamma ray astrophysics
[DE87-006293] N87-21842
COSMOCHEMISTRY
Laser microprobe studies of rare gas isotopes in meteorites N87-21769
COSMONAUTS
Inception of Soviet system of medical screening of cosmonauts (hospital stage) N87-21559
COSPAS
Canadian Coast Guard 406 MHz EPIRB (Emergency Position Indicating Radiobeacon) experimental results
[AD-A176430] N87-20978
COST ANALYSIS
Design and development of a multi-kilowatt hour hydrogen/nickel oxide battery
[DE87-006774] N87-21250
COULOMB COLLISIONS
The quasi-linear relaxation of thick-target electron beams in solar flares N87-21825
COUPLED MODES
Study of an optimum design problem with frequency criteria applied to a structure-fluid coupled system
[ECL-86-06] N87-21396
COUPLING
Saturation effects in coupled lasers with homogeneous gain
[AD-A176843] N87-21314
CRAB NEBULA
The hard X-ray to low energy Gamma-Ray spectrum of the crab nebula N87-21761
CRACK INITIATION
The micromechanics of damage initiation and development under static and fatique loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99985] N87-21044
CRACK PROPAGATION
The micromechanics of damage initiation and development under static and fatique loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99985] N87-21044
Stress corrosion cracking and metal-induced embrittlement: Comparative studies of local chemistries
[DE87-004300] N87-21097
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378
Measurement of fatigue crack growth kinetics of Copper-Kapton laminates by dynamic mechanical thermal analysis
[DE87-003024] N87-21390

Origin of cracking phenomena observed in decomposition reactions
[DE87-000199] N87-21392
Fatigue crack growth under cyclic compression: Role of first load cycle
[FFA-TN-1986-71] N87-21398

CRACK TIPS
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382

CRACKING (FRACTURING)
Defect and damage characterization in composite materials
[AD-A176335] N87-21047

CRACKS
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378
Full-field stress-strain analysis of cracking plates
[AD-A176966] N87-21383
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384

CREEP PROPERTIES
Fundamentals of hardening and decohesion behavior in time-dependent cycle deformation
[DE87-003995] N87-21091
Creep cavitation in a nickel aluminide
[DE87-004392] N87-21106

CREW PROCEDURES (INFLIGHT)
Ground Proximity Warning System (GPWS): Guidance material
[CAP-516] N87-20977

CRITERIA
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382

CROP GROWTH
Foundations and applications of multispectral scanning in agriculture
[NLR-MP-85015-U] N87-21408

CROP IDENTIFICATION
Foundations and applications of multispectral scanning in agriculture
[NLR-MP-85015-U] N87-21408

CROSSLINKING
Network polymers formed under nonideal conditions
[AD-A176408] N87-21115

CROSSOVERS
Nature of coupling and dimensional crossover in superconducting multilayers
[DE87-004676] N87-21706

CRYOGENIC COOLING
Microgravity fluid management requirements of advanced solar dynamic power systems N87-21153

CRYOGENIC EQUIPMENT
Pool type liquid helium cryopump
[DE87-701268] N87-21349

CRYOGENIC FLUID STORAGE
Advanced long term cryogenic storage systems N87-21142
Long term cryogenic storage facility systems study N87-21143
Space station experiment definition: Long term cryogenic fluid storage N87-21144
Helium technology issues N87-21145
Overview: Fluid acquisition and transfer N87-21146
The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement N87-21147
Numerical modelling of cryogenic propellant behavior in low-G N87-21148
Mixing-induced fluid destratification and ullage condensation N87-21149
Cryogenic Fluid Management Flight Experiment (CFMFE) N87-21150
Superfluid helium on orbit transfer (SHOOT) N87-21151
Microgravity fluid management in two-phase thermal systems N87-21152

CRYOGENIC FLUIDS
High-throughput continuous cryopump
[DE87-000396] N87-21343

CRYOGENIC ROCKET PROPELLANTS
Long term cryogenic storage facility systems study N87-21143
Numerical modelling of cryogenic propellant behavior in low-G N87-21148

CRYOGENICS
Research on cryogenic vacuum tunneling
[AD-A176363] N87-21082
Research on cryogenic vacuum tunneling
[AD-A176390] N87-21662

CRYOPUMPING
High-throughput continuous cryopump
[DE87-000396] N87-21343
Pool type liquid helium cryopump
[DE87-701268] N87-21349

CRYSTAL DISLOCATIONS
Effect of aluminum addition on ductility and yield strength of Fe3Al alloys with 0.5 wt % TiB2
[DE87-004621] N87-21096
Stress and efficiency studies in EFG
[NASA-CR-180527] N87-21412

CRYSTAL GROWTH
Stress and efficiency studies in EFG
[NASA-CR-180527] N87-21412
Diffusion and defect characterization of mercury cadmium telluride
[AD-A176323] N87-21690
Kinetics and thermodynamics of quasicrystals as determined by surface modification techniques
[DE87-005538] N87-21713

CRYSTAL LATTICES
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Superlattice effects in graphite intercalation compounds
[AD-A176879] N87-21694
The 2-4 semiconductor superlattices
[AD-A177092] N87-21696

CRYSTAL STRUCTURE
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
Effect of grain boundary structure on sensitization and corrosion of stainless steel
[AD-A176299] N87-21081
Research on cryogenic vacuum tunneling
[AD-A176363] N87-21082

CRYSTAL SURFACES
Ellipsometric and photoluminescent characterization of H2 and N2 multipolar plasma interactions with the 100 GaAs crystal surface
[INSA-IDI-186-05] N87-21687

CRYSTALLINITY
Fluctuations in membranes with crystalline and hexatic order
[PREPRINT-538] N87-21402

CRYSTALLIZATION
Aluminum-air battery crystallizer
[DE87-005839] N87-21252

CRYSTALLOGRAPHY
Effect of grain boundary structure on sensitization and corrosion of stainless steel
[AD-A176299] N87-21081
Computer generation of convergent beam electron diffraction patterns — crystallography
[ETN-87-99578] N87-21719
Crystal data: Version 1.0 database specifications
[PB87-140414] N87-21724

CRYSTALS
A microscopic theory for the Brillouin intensities evaluation in noble gas crystals
[PREPRINT-521] N87-21721
Evaluation of Brillouin scattering intensities from rare gas crystals. Part 1: A pure dipole induced dipole theory
[PREPRINT-535] N87-21722

CUMULUS CLOUDS
Convective scale interaction: Arc cloud lines and the development and evolution of deep convection N87-21424
A numerical investigation of an orogenic mesoscale convective system N87-21425

CURING
Ultrasonic cure characterization of epoxy resins: Constitutive modeling
[AD-A176661] N87-21116

CURRENT ALGEBRA
The octet nonleptonic Hamiltonian and current algebra on the lattice with Wilson fermions
[PREPRINT-525] N87-21636

CURRENT SHEETS
Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares N87-21805
The generation of rapid solar flare hard X-ray and microwave fluctuations in current sheets N87-21824

CURVATURE
The effects of curvature on the stiffness of laterally loaded rectangular plates
[NPL-DMA(A)-122] N87-21370

CUTTING
Precision cutting and drilling with the Nd-YAG laser
[DE87-001359] N87-21317

CYCLIC LOADS
Thermomechanical effects in inelastic materials and structures
[AD-A177076] N87-21386
Fatigue crack growth under cyclic compression: Role of first load cycle
[FFA-TN-1986-71] N87-21398

CYCLOGENESIS
Alpine lee cyclogenesis: Numerical simulation and theory N87-21498
A theory of deep cyclogenesis in the lee of the Alps: Modification of baroclinic instability by topography N87-21499
The mechanisms of orographic cyclogenesis N87-21500
A normal mode nongeostrophic model of lee cyclogenesis N87-21501
Spanish Limited Area Model (LAM) behavior in two cases of Mediterranean cyclogenesis N87-21502
Representation of pressure drag effects in numerical modeling of Alpine cyclogenesis N87-21503
Numerical simulation of lee cyclogenesis during Alpine Experiment with an isentropic coordinate model N87-21504
The role of Alps mountains representation in the lee cyclogenesis simulation N87-21505
On the synoptics and dynamics of orographically induced cyclones in the Mediterranean N87-21506
Vorticity budgets for Alpine cyclogenesis with and without the forcing of terrain N87-21508
Fine mesh analysis of Genoa cyclogenesis by use of isentropic coordinates N87-21509
Nonalpine contribution to Mediterranean cyclogenesis: Synoptic study of two cases which occurred during Alpine Experiment (ALPEX) Special Observing Period N87-21510
Comparative study of several cases of Alpine lee-cyclogenesis: Kinetic energy and vorticity N87-21512
Effects of terrain height and blocking initialization on numerical simulation of Alpine lee cyclogenesis N87-21515

CYCLONES
Quasi-Lagrangian diagnostics of a Mediterranean cyclone: Isentropic results N87-21507

CYCLOTRON RADIATION
Electron-cyclotron maser and solar microwave millisecond spike emission N87-21619

CYLINDRICAL SHELLS
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
Penalization study of a variational inequalities system used to model a cylindrical shell with symmetric loading
[ECL-86-09] N87-21397

CZOCHRALSKI METHOD
Three-dimensional numerical studies of the physics of semiconductor crystal growth
[AD-A176806] N87-21693

D

DAMAGE
Defect and damage characterization in composite materials
[AD-A176335] N87-21047
Elastic interactions of a crack with damage and associated energy release rates
[AD-A177071] N87-21385

DAMAGE ASSESSMENT
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048

DATA ACQUISITION
Hardware design for a fixed-wing airborne gravity measurement system
[AD-A176620] N87-20993
High response data acquisition system N87-21189
Acquisition and analysis of dynamic rotating machinery data N87-21190
Acquisition and processing of non-stationary pressure measurments in studies of air intake distortion N87-21191
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
A quick look at the first NRL short pulse 95 GHz radar flight data
[AD-A176182] N87-21214
Composite service life prediction via fiber bundle testing. Evaluation of testing equipment and data acquisition system
[AD-A176835] N87-21365
Development and operation of a measuring data acquisition system for use in light airplanes N87-21467
Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521

Technical description of an acoustic Doppler based upper ocean profiling system
[PB87-142162] N87-21551
Using vision systems when bar code won't work
[DE87-004514] N87-21740

DATA BASE MANAGEMENT SYSTEMS
Information systems inventory user instruction manual
[PB87-131009] N87-21612
A modeling and simulation tool for fault-tolerant distributed systems applied to distributed database management systems
[KFK-4138] N87-21614
Crystal data: Version 1.0 database specifications
[PB87-140414] N87-21724
Using bar code technology to enhance classified document accountability
[DE87-000760] N87-21739
Flexible and dynamic data model applied in an engineering data management system
[NLR-MP-85011-U] N87-21741
Materials Information for Science and Technology (MIST): Project overview
[PB87-136677] N87-21750
Application of the maximum entropy principle to retrieval from very large databases
[PB87-115523] N87-21752

DATA BASES
Filament wound data base development, revision 1, appendix A
[NASA-CR-179069] N87-21015
Filament wound data base development, revision 1
[NASA-CR-179068-REV-1] N87-21016
Filament wound data base development, revision 1, appendix B
[NASA-CR-179070] N87-21017
Compressive properties and laser absorptivity of unidirectional metal matrix composites
[AD-A176194] N87-21046
Ductile iron data base. Correlations between microstructure and fracture toughness: Background document for draft ASTM ductile iron specification
[DE87-006010] N87-21107
Reliability growth prediction
[AD-A176128] N87-21362
Analysis and quality of Alpine Experiment (ALPEX) data N87-21488
Meteosat contribution to Alpine Experiment (ALPEX): Highlights and limits N87-21495
Fusion technology projects
[ECN-185] N87-21689
Flexible and dynamic data model applied in an engineering data management system
[NLR-MP-85011-U] N87-21741
A new methodology of determining directional albedo models from Nimbus 7 ERB scanning radiometer measurements
[NASA-CR-177906] N87-21764
Comparison of long-wave and shortwave irradiances at satellite altitude with integrated scanner measurements using the Nimbus 7 ERB data set
[NASA-CR-177909] N87-21834

DATA CONVERSION ROUTINES
A coordinate conversion algorithm for multisensor data processing
[AD-A176368] N87-21603

DATA CORRELATION
Processing techniques for correlation of LDA and thermocouple signals N87-21194

DATA FLOW ANALYSIS
Exploiting loop level parallelism in nonprocedural dataflow programs
[NASA-CR-178277] N87-21613

DATA LINKS
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023
The Aircraft to Satellite Data Relay: ASDAR N87-21478

DATA MANAGEMENT
Atmospheric climate data: Problems and promises
[NASA-CR-180442] N87-21450

DATA PROCESSING
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985
Acquisition and analysis of dynamic rotating machinery data N87-21190
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
Accuracy and error analysis — flight test measurement errors N87-21468
Four-dimensional data assimilation — numerical weather forecasting N87-21481
Assessment of results from different analysis schemes — GARP N87-21482
Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521
A coordinate conversion algorithm for multisensor data processing
[AD-A176368] N87-21603
NILFIT: An interactive system for nonlinear fit of data
[HMI-B431] N87-21607
Applied informatics in practice
[NLR-MP-85028-U] N87-21742
Advanced sensors, telecommunications and data processing: Technological spin-offs from the Strategic Defense Initiative
[DE87-003884] N87-21757
A new methodology of determining directional albedo models from Nimbus 7 ERB scanning radiometer measurements
[NASA-CR-177906] N87-21764
Comparison of long-wave and shortwave irradiances at satellite altitude with integrated scanner measurements using the Nimbus 7 ERB data set
[NASA-CR-177909] N87-21834

DATA PROCESSING EQUIPMENT
Composite service life prediction via fiber bundle testing. Evaluation of testing equipment and data acquisition system
[AD-A176835] N87-21365

DATA PROCESSING TERMINALS
Multispeaker number recognition
[ENST-86E008] N87-21225

DATA REDUCTION
Fluxgate magnetometer analysis and simulation software for the Combined Release and Radiation Effects Satellite (CRRES)
[AD-A176353] N87-21032
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
Solution of the three-dimensional Navier-Stokes equations for a turbulent horseshoe vortex flow
[AD-A176370] N87-21263
Analysis and quality of Alpine Experiment (ALPEX) data N87-21488
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986
[AD-A176795] N87-21544

DATA RETRIEVAL
Application of the maximum entropy principle to retrieval from very large databases
[PB87-115523] N87-21752

DATA SYSTEMS
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985

DECELERATION
A theoretical examination of a reentry capsule incorporating an autorotating rotor
[AD-A176854] N87-21026

DECIMETER WAVES
Relation between solar narrow-band decimeter wave bursts and associated X-ray bursts N87-21799

DECISION MAKING
FY86 independent research/independent exploratory development
[AD-A176944] N87-21589

DECODERS
Reed-Solomon decoder
[NASA-CASE-NPO-15982-1] N87-21591

DECOMPOSITION
Origin of cracking phenomena observed in decomposition reactions
[DE87-000199] N87-21392

DECOMPRESSION SICKNESS
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness
[AD-A176558] N87-21556

DEEP SPACE
Present and future military uses of outer space: International law, politics, and the practice of states
[AD-A176722] N87-21753

DEFECTS
Defect and damage characterization in composite materials
[AD-A176335] N87-21047

DEFENSE PROGRAM
Advanced sensors, telecommunications and data processing: Technological spin-offs from the Strategic Defense Initiative
[DE87-003884] N87-21757

DEFLECTION
Computer aided design of magnetic deflection systems
[ETN-87-99583] N87-21608

DEFORMATION
Resistance curve approach to predicting residual strength of composites
[AD-A176984] N87-21050
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE87-006152] N87-21103
Dynamics of flexible structures performing large overall motions: A geometrically-nonlinear approach N87-21335
Nonlinear viscoelastic analysis of adhesively bonded joints
[AD-A176494] N87-21379

DEGRADATION
Defect and damage characterization in composite materials
[AD-A176335] N87-21047

DEGREES OF FREEDOM
Mobile robots in research and development programs at the Savannah River site
[DE87-003114] N87-21352

DEICING
Ground de-icing of aircraft
[CAP-512] N87-20975

DELAMINATING
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Part A: Adhesion and delamination
[ETN-87-99576] N87-21056
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination
[ETN-87-99577] N87-21057
Convergence of strain energy release rate components for edge-delaminated composite laminates
[NASA-TM-89135] N87-21377

DEMINERALIZING
Individual distinctions of fluid-electrolyte metabolism during hypokinesia with head-down tilt for 120 days and efficacy of preventive agents N87-21562

DEMODULATION
Analysis of vibration data from WHL (Westland Helicopters Limited) Wessex fatigue test trial 3
[AD-A176208] N87-21003

DENSIFICATION
Densification of titanium powder during hot isostatic pressing
[AD-A176617] N87-21084

DENSITY MEASUREMENT
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539

DEPLOYMENT
A theoretical examination of a reentry capsule incorporating an autorotating rotor
[AD-A176854] N87-21026

DEPOSITION
Investigations into the origins of the physical structure of thin films
[AD-A176943] N87-21117
Traveling-wave-tube efficiency improvement by a low-cost technique for deposition of carbon on multistage depressed collector
[NASA-TP-2719] N87-21239

DESIGN ANALYSIS
A new design concept for indraft wind-tunnel inlets with application to the national full-scale aerodynamic complex
[NASA-TM-88226] N87-21006
Block 2 SRM conceptual design studies. Volume 1, Book 2: Preliminary development and verification plan
[NASA-CR-179054] N87-21036
Failure strengths of laminated glass units
[PB87-118873] N87-21113
Two-phase reduced gravity experiments for a space reactor design N87-21154
Maintenance evaluation for space station liquid systems N87-21155
Algorithms used in ARROWS: Autodesign of radio relay optimum wideband systems
[PB87-126405] N87-21229
Impact verification of space suit design for space station
[NASA-CR-180456] N87-21584

DETECTION
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048

Approach to evaluating leak detection methods in underground storage tanks
[PB87-118444] N87-21168
Three-dimensional sensing and interpretation
[AD-A176906] N87-21340
Ultrasonic NDE of green-state ceramic using focused through-transmission
[DE87-001494] N87-21367
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176662] N87-21433

DEUTERIUM
Muonic X-ray laser assisted by catalyzed fusion of deuterium and tritium
[DE87-004851] N87-21327

DEUTERONS
Magnetic moments of multiquark states and limit on the six-quark bag admixture in the deuteron wave function
[PREPRINT-537] N87-21673

DEVELOPING NATIONS
Satellites and developing countries: Purpose, problems, and progress
[AD-A176536] N87-21022

DIAMAGNETISM
Theoretical investigations of releases of lithium in the Earth's magnetosphere
[AD-A177060] N87-21437
Observations and theory of the AMPTE (Active Magnetospheric Particle Tracer Explorers) magnetotail barium releases
[DE87-006325] N87-21440

DIELECTRICS
Space-charge-induced breakdown in dielectrics
[AD-A176969] N87-21029
Scattering of surface waves by nonuniform waveguides
[AD-A176632] N87-21219
Studies of millimeter-wave diffraction devices and materials. Phase 3
[AD-A176917] N87-21244
Laser evaporation studies
[AD-A176826] N87-21313
Measurement of dielectric properties of minerals at microwave frequencies, report of investigations 1986
[PB87-116968] N87-21723

DIESEL ENGINES
Diesel engine combustion program at the Defence Research Establishment Ottawa
[AD-A176436] N87-21336

DIESEL FUELS
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136

DIFFERENTIAL EQUATIONS
Some computational results on size reduction in H sup inf design
[OUEL-1648/86] N87-21627

DIFFRACTION
Studies of millimeter-wave diffraction devices and materials. Phase 3
[AD-A176917] N87-21244

DIFFRACTION PATTERNS
Automatic processing system for shadowgraph and interference patterns
[NASA-TM-88525] N87-21307
Computer generation of convergent beam electron diffraction patterns — crystallography
[ETN-87-99578] N87-21719

DIFFUSION
Mixing in a double-diffusive, partially stratified fluid
[DE87-001131] N87-21285
Atmospheric transport and dispersion of pollutants and related meteorological studies: Program summary
[DE87-005644] N87-21418
EXAFS studies of grain boundary diffusion and segregation
[DE87-003435] N87-21702

DIFFUSION FLAMES
Size and shape of solid fuel diffusion flames in very low speed flows
[NASA-CR-179576] N87-21129

DIFFUSION WELDING
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Development of the diffusion bonding process
[DE87-006598] N87-21164

DIGITAL DATA
Digital image processing applied to fluid dynamic problems N87-21193

DIGITAL ELECTRONICS
Results and analysis of static and dynamic multipath in a severe atmospheric environment
[PB87-131165] N87-21231

DIGITAL FILTERS
Investigation into the characteristics of ZnSe filters
[RSRE-MEMO-3993] N87-21680

DIGITAL SIMULATION
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264

DIGITAL SYSTEMS
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023
Cosmic ray effects on microelectronics. Part 4
[AD-A176611] N87-21242

DIGITAL TECHNIQUES
The fundamentals of timing and synchronization for digital communication networks
[AD-A176721] N87-21220

DIMENSIONAL MEASUREMENT
Inspection of complex profiles: A review of the methods available, and best suited to the needs of RAE Pyestock
[RAE-TM-P-1077] N87-21306

DIODES
Comparison between calculated and measured forward and reverse current-voltage characteristics
[AD-A176607] N87-21241

DIRECT CURRENT
Four quadrant control circuit for a brushless three-phase dc motor
[NASA-CASE-MFS-28080-1] N87-21233

DIRECT POWER GENERATORS
Bidirectional control system for energy flow in solar powered flywheel
[NASA-CASE-MFS-25978-1] N87-21410

DISPLACEMENT
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382

DISPLACEMENT MEASUREMENT
The improvement and evaluation of a laser interferometer for the absolute measurement of ultrasonic displacements in the frequency range up to 15 MHz — hydrophones
[NPL-AC-109] N87-21311

DISPLAY DEVICES
Electronic display equipment for use in the advanced flight deck simulator at British Aerospace, Weybridge
[RID-1912] N87-21005

DISSOLVING
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535

DISTORTION
Wing divergence and structural distortion
[RAE-TR-85057] N87-20989

DIVERGENCE
Wing divergence and structural distortion
[RAE-TR-85057] N87-20989
Divergence and flutter of swept-forward wings with crossflexibilities
[RAE-TR-86047] N87-21000

DMSP SATELLITES
Development of techniques for the use of DMSP (Defense Meteorology Satellite Program) SSIE (Topside Ionospheric Plasma Monitor) data in the AWS (Air Weather Service) 4D ionosphere model
[AD-A176412] N87-21430

DOCUMENT STORAGE
MARC (Machine Readable Catalog) format and life cycle tracking at the National Archives: A study
[PB87-126256] N87-21737

DOCUMENTATION
Document preparation guide
[DE86-015942] N87-21738
Using bar code technology to enhance classified document accountability
[DE87-000760] N87-21739

DOCUMENTS
Publications of the National Bureau of Standards, 1985 catalog
[PB87-145272] N87-21751

DOPPLER EFFECT
Application of Doppler and transit laser anemometry in small turbomachines N87-21180
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176662] N87-21433
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539
Technical description of an acoustic Doppler based upper ocean profiling system
[PB87-142162] N87-21551

DRAFT (GAS FLOW)
A prediction method for the air-droplets flow in the inlet section of a natural draft cooling tower
[VKI-TM-40] N87-21301

DRAG
A theoretical examination of a reentry capsule incorporating an autorotating rotor
[AD-A176654] N87-21026

DRAG MEASUREMENT
Challenges in modeling the X-29 flight test performance
[NASA-TM-88282] N87-20991

DRAG REDUCTION
Summary of studies to reduce wing-mounted propfan installation drag on an M = 0.8 transport
[NASA-TP-2678] N87-20990
European Science Notes, Volume 41, Number 2
[AD-A176116] N87-21843

DRIFT RATE
A drift chamber with variable drift velocity
[NIKHEF-H/86-12] N87-21310

DRILLING
Precision cutting and drilling with the Nd-YAG laser
[DE87-001359] N87-21317

DRIVES
Evaluation of the OSI LD1200 optical diskdrive
[NIKHEF-H/86-17] N87-21744

DROPS (LIQUIDS)
A self-similar approach to the explosion of droplets by a high energy laser beam
[DE87-005124] N87-21322

DUCTILITY
Ductile fracture and random versus regular hole/void arrays
[AD-A176627] N87-21085
Effect of aluminum addition on ductility and yield strength of Fe3Al alloys with 0.5 wt % TiB2
[DE87-004621] N87-21098
Ductile iron data base. Correlations between microstructure and fracture toughness: Background document for draft ASTM ductile iron specification
[DE87-006010] N87-21107

DUMMIES
Preliminary development, head-neck simulator. Volume 1: Analysis volunteer tests
[PB87-133245] N87-21553

DWARF STARS
Using nonradial pulsations to determine the envelope composition of very evolved stars
[DE87-001982] N87-21765

DYE LASERS
Nonlinear optics with broad-band lasers
[DE87-004306] N87-21319

DYNAMIC CHARACTERISTICS
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
Wave-mode coordinates and scattering matrices for wave propagation
[AD-A176998] N87-21030
On impact dynamics of robotic operations
[AD-A176464] N87-21337
The near-minimum time control of a robot arm
[AD-A176875] N87-21339
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535

DYNAMIC CONTROL
Experimental studies on the dynamic development and control of unsteady separated flows
[AD-A176376] N87-20969
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms
[AD-A176218] N87-20983
Stabilization and control problems in structural dynamics
[AD-A177183] N87-21389

DYNAMIC MODELS
Modeling and experimental validation of a single-link flexible manipulator
[AD-A176614] N87-21338
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655

DYNAMIC RESPONSE
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
Preliminary report on candidates for AGARD standard aeroelastic configurations for dynamic response
[NASA-TM-89142] N87-21376
Stabilization and control problems in structural dynamics
[AD-A177183] N87-21389
DYNAMIC STABILITY
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341
DYNAMIC STRUCTURAL ANALYSIS
The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary
[NASA-CR-178276] N87-21020
Dynamics of flexible structures performing large overall motions: A geometrically-nonlinear approach
N87-21335
Stabilization and control problems in structural dynamics
[AD-A177183] N87-21389
DYNAMICAL SYSTEMS
The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement N87-21147
Geophysical Fluid Dynamics Laboratory activities FY86, plans FY87
[PB87-134458] N87-21403
Intermittency as multifractality in history space
[PREPRINT-518] N87-21639
Symmetries and bi-Hamiltonian structures of 2+1 dimensional systems
[PREPRINT-536] N87-21644

E

E GLASS
The micromechanics of damage initiation and development under static and fatique loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99985] N87-21044
EARTH IONOSPHERE
Retarding potential analyzer research
[NASA-CR-180508] N87-21427
Development of techniques for the use of DMSP (Defense Meteorology Satellite Program) SSIE (Topside Ionospheric Plasma Monitor) data in the AWS (Air Weather Service) 4D ionosphere model
[AD-A176412] N87-21430
EARTH MOVEMENTS
Study of the free oscillations of the Earth based on gravitional antenna data
[NOTA-INTERNA-668] N87-21447
EARTH ORBITAL ENVIRONMENTS
Advanced long term cryogenic storage systems
N87-21142
Long term cryogenic storage facility systems study
N87-21143
EARTH ORBITS
A theoretical examination of a reentry capsule incorporating an autorotating rotor
[AD-A176854] N87-21026
The representation of the Earth's gravitational potential in a spherical harmonic expansion to degree 250
[AD-A176479] N87-21431
EARTH RADIATION BUDGET EXPERIMENT
A new methodology of determining directional albedo models from Nimbus 7 ERB scanning radiometer measurements
[NASA-CR-177908] N87-21764
Comparison of long-wave and shortwave irradiances at satellite altitude with integrated scanner measurements using the Nimbus 7 ERB data set
[NASA-CR-177909] N87-21834
EARTH SURFACE
Ellipsoidal corrections to potential coefficients obtained from gravity anomaly data on the ellipsoid
[AD-A176901] N87-21435
EARTH TIDES
Tidal estimation in the Atlantic and Indian Oceans, 3 deg x 3 deg solution
[NASA-TM-87812] N87-21534
EARTHQUAKES
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023
ECHOES
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176662] N87-21433
ECONOMIC ANALYSIS
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 1: Executive summary
[NASA-CR-179597-VOL-1] N87-21212
The use of satellites in non-goestationary orbits for unloading geostationary communication satellite traffic peaks. Volume 2: Technical report
[NASA-CR-179597-VOL-2] N87-21213
ECONOMY
Improving the transfer and use of scientific and technical information: The Federal role. Volume 1: Summary and conclusions
[PB87-142915] N87-21746
EDGE LOADING
The effects of curvature on the stiffness of laterally loaded rectangular plates
[NPL-DMA(A)-122] N87-21370
EDUCATION
Introduction to the Z80 didactic assembly
[NOTA-INTERNA-670] N87-21595
EFFICIENCY
An overview of the long pulse experiment
[DE87-003738] N87-21326
EINSTEIN EQUATIONS
Inflation in spherically symmetric inhomogeneous models
[DE87-005405] N87-21779
ELASTIC ANISOTROPY
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378
ELASTIC DEFORMATION
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382
Full-field stress-strain analysis of cracking plates
[AD-A176986] N87-21383
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384
Thermomechanical effects in inelastic materials and structures
[AD-A177076] N87-21386
Fluctuations in membranes with crystalline and hexatic order
[PREPRINT-538] N87-21402
ELASTIC PLATES
Calculation of the effect of a point impact on an infinite elastic plate adjacent to a semi-infinite fluid
[NPL-DITC-80/86] N87-21389
Full-field stress-strain analysis of cracking plates
[AD-A176986] N87-21383
ELASTIC PROPERTIES
Strain and stress cycling in elastic-plastic materials
N87-21372
Elastic interactions of a crack with damage and associated energy release rates
[AD-A177071] N87-21385
Identification of material constants for a composite shell structure
[DE87-004524] N87-21395
Study of an optimum design problem with frequency criteria applied to a structure-fluid coupled system
[ECL-86-06] N87-21396
ELASTIC SHELLS
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
ELASTODYNAMICS
Self-adaptive Finite Element (FE) analysis of solid structures. Part 1: Element formulation and a posteriori error estimation
[FFA-TN-1986-27] N87-21400
ELASTOPLASTICITY
Mathematical and numerical study of a single side contact friction problem in elasticity and elastoplasticity
[ECL-85-09] N87-21358
ELECTRIC ARCS
Tetrahydrogen
[AD-A176778] N87-21133
ELECTRIC BATTERIES
Proceedings of the International Workshop on High-Temperature Molten Salt Batteries
[DE87-003297] N87-21248
Battery thermal modeling: The methodology and applications
[DE87-004865] N87-21249
ELECTRIC CHARGE
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft
[AD-A176815] N87-21024
Progress toward predicting high-voltage charging of spacecraft in low polar orbit
[AD-A176939] N87-21027
ELECTRIC CURRENT
Four quadrant control circuit for a brushless three-phase dc motor
[NASA-CASE-MFS-28080-1] N87-21233
ELECTRIC DISCHARGES
Tetrahydrogen
[AD-A176778] N87-21133
Millimeter wave generation by relativistic electron beams
[AD-A176949] N87-21245
ELECTRIC FIELDS
Field assisted etching
[RSRE-MEMO-3715] N87-21161
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217
Retarding potential analyzer research
[NASA-CR-180508] N87-21427
Original improvements of the TLM method
[RAE-TRANS-2151] N87-21624
Field effect and Josephson junction
[DE87-004473] N87-21701
Solar wind plasma in the magnetosphere method of entry and consequences
[AD-A177255] N87-21835
ELECTRIC MOTORS
Four quadrant control circuit for a brushless three-phase dc motor
[NASA-CASE-MFS-28080-1] N87-21233
ELECTRIC NETWORKS
Macromodeling of digital circuits
[AD-A176874] N87-21243
Papers presented at a Workshop on Electric Energy Systems Research
[PB87-137238] N87-21254
ELECTRIC POTENTIAL
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft
[AD-A176815] N87-21024
Calculation of equilibrated concentrations of constituents of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte and corresponding values of theoretical voltage of dissociation N87-21[illegible]3
ELECTRIC POWER PLANTS
Materials for large land-based gas turbines
[PB87-120531] N87-20998
ELECTRIC SWITCHES
Four quadrant control circuit for a brushless three-phase dc motor
[NASA-CASE-MFS-28080-1] N87-21233
ELECTRIC TERMINALS
Test methodology for adaptive antenna systems
[AD-A176295] N87-21215
ELECTRICAL ENGINEERING
Basic research in electronics: Joint Services Electronics Program (JSEP)
[AD-A177067] N87-21247
Activities report in electrical technology
[ETN-87-99354] N87-21253
ELECTRICAL FAULTS
Space-charge-induced breakdown in dielectrics
[AD-A176969] N87-21029
Comparison between calculated and measured forward and reverse current-voltage characteristics
[AD-A176607] N87-21241
ELECTRICAL MEASUREMENT
Assessment of remaining lubricant life
[AD-A177186] N87-21121
A calibrtion procedure for a coherent polarimetric radar
[RSRE-MEMO-3889] N87-21211
ELECTRICAL PROPERTIES
Transport properties of GaAs. Contribution to the study of GaAs/(Ca,Sr)F2 structures using molecular beam epitaxy
[LAAS-86-330] N87-21718
Measurement of dielectric properties of minerals at microwave frequencies, report of investigations 1986
[PB87-116988] N87-21723
ELECTRICAL RESISTANCE
Effects of stresses on the phase transformation of NITINOL
[AD-A177053] N87-21090
ELECTRICAL RESISTIVITY
Plasma turbulence and impulsive UV line emission in solar flares N87-21818
ELECTRO-OPTICS
LLE review
[DE87-005865] N87-21324
European Science Notes, Volume 41, Number 2
[AD-A176116] N87-21843

ELECTROCHEMICAL CELLS
Operations handbook-ozone measurements to 40-km altitude with Model 4A Electrochemical Concentration Cell (ECC) ozonesonaes (used with 1680-MHz radiosondes) [PB87-113874] N87-21426
ELECTROCHEMISTRY
The electrocatalysts of dioxygen reduction on transition metal chelates [ETN-87-99584] N87-21070
Inhibition of localized corrosion [AD-A176573] N87-21083
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys [AD-A176970] N87-21089
Diffusion and defect characterization of mercury cadmium telluride [AD-A176323] N87-21690
ELECTRODEPOSITION
Development of the diffusion bonding process [DE87-006598] N87-21164
ELECTRODES
Traveling-wave-tube efficiency improvement by a low-cost technique for deposition of carbon on multistage depressed collector [NASA-TP-2719] N87-21239
ELECTRODYNAMICS
Retarding potential analyzer research [NASA-CR-180508] N87-21427
ELECTROHYDRODYNAMICS
Electrokinetic and hydrodynamic transport through porous media [ETN-87-99581] N87-21299
ELECTROKINETICS
Electrokinetic and hydrodynamic transport through porous media [ETN-87-99581] N87-21299
ELECTROLYTE METABOLISM
Individual distinctions of fluid-electrolyte metabolism during hypokinesia with head-down tilt for 120 days and efficacy of preventive agents N87-21562
Bioelectrical activity of the heart and blood electrolytes in essentially healthy subjects submitted to antiorthostatic hypokinesia for 120 days N87-21563
ELECTROLYTES
Proceedings of the International Workshop on High-Temperature Molten Salt Batteries [DE87-003297] N87-21248
ELECTROMAGNETIC ABSORPTION
The low frequency space array [AD-A177115] N87-21758
ELECTROMAGNETIC FIELDS
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case [AD-A176483] N87-21217
A study of the propagation of ULF electromagnetic fields in collisional, inhomogeneous, magnetized plasmas [DE87-004768] N87-21223
Handbook for operation and maintenance of an NBS (National Bureau of Standards) multisensor automated EM (electromagnetic) field measurement system [PB87-140729] N87-21749
ELECTROMAGNETIC INTERFERENCE
Macromodeling of digital circuits [AD-A176874] N87-21243
Technical publication announcements covering Center programs, January to March 1986 [PB87-140273] N87-21748
ELECTROMAGNETIC PROPERTIES
Measurement apparatus and procedure for the determination of surface emissivities [NASA-CASE-LAR-13455-1] N87-21206
ELECTROMAGNETIC PROPULSION
The NASA Electric Propulsion Program [NASA-TM-89856] N87-21037
ELECTROMAGNETIC PULSES
Efficient methods for evaluating the effects of stressful electromagnetic environments on complex systems [DE86-008030] N87-21224
ELECTROMAGNETIC RADIATION
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes [AD-A176590] N87-21023
ELECTROMAGNETIC SCATTERING
Scattering from general periodic screens [AD-A176405] N87-21216
ELECTROMAGNETIC WAVE TRANSMISSION
Millimeter wave generation by relativistic electron beams [AD-A176949] N87-21245
ELECTROMAGNETISM
Basic research in electronics: Joint Services Electronics Program (JSEP) [AD-A177067] N87-21247
ELECTROMECHANICS
Advanced Electromechanical Actuation System (EMAS), flight test [AD-A176148] N87-21001
ELECTRON ACCELERATION
Shock acceleration of electrons and ions in solar flares N87-21823
ELECTRON ACCELERATORS
Millimeter wave generation by relativistic electron beams [AD-A176949] N87-21245
ELECTRON BEAMS
A 1-ms electron beam facility for laser kinetic studies [DE87-003299] N87-21323
Computer generation of convergent beam electron diffraction patterns — crystallography [ETN-87-99578] N87-21719
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810
The effect of beam-driven return current instability on solar hard X-ray bursts N87-21820
The quasi-linear relaxation of thick-target electron beams in solar flares N87-21825
ELECTRON CYCLOTRON HEATING
Electron-cyclotron maser emission during flares: Emission in various modes and temporal variations N87-21821
ELECTRON DENSITY (CONCENTRATION)
Sub-second variations of high energy (300 keV) hard X-ray emission from solar flares N87-21787
ELECTRON DENSITY PROFILES
Development of techniques for the use of DMSP (Defense Meteorology Satellite Program) SSIE (Topside Ionospheric Plasma Monitor) data in the AWS (Air Weather Service) 4D ionosphere model [AD-A176412] N87-21430
Model results with PIIE (Polar Ionospheric Irregularities Experiment) rocket data [AD-A176999] N87-21436
ELECTRON GUNS
Generation of intense negative ion beams [NASA-CASE-NPO-16061-1-CU] N87-21660
ELECTRON MICROSCOPY
Analysis of picosecond pulsed laser melted graphite [DE87-003755] N87-21124
ELECTRON PRECIPITATION
Investigation of precipitating electrons during an auroral breakup [KGI-PREPRINT-096] N87-21444
Average configuration of the quiet auroral oval [DMI-GEOPHYS-PAPERS-R-73] N87-21446
ELECTRON SPECTROSCOPY
Investigation of precipitating electrons during an auroral breakup [KGI-PREPRINT-096] N87-21444
ELECTRON STATES
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces [AD-A176445] N87-21691
ELECTRON TRANSFER
Development of chemical sensors: Empirical art or systematic research? [DRIC-T-7783] N87-21059
Vectorial electron transfer on designed surfaces [PB87-144325] N87-21137
ELECTRONIC EQUIPMENT
Efficient methods for evaluating the effects of stressful electromagnetic environments on complex systems [DE86-008030] N87-21224
Comparison between calculated and measured forward and reverse current-voltage characteristics [AD-A176607] N87-21241
Cosmic ray effects on microelectronics. Part 4 [AD-A176611] N87-21242
Reliability growth prediction [AD-A176128] N87-21362
ELECTRONIC MODULES
Introduction to the Z80 didactic assembly [NOTA-INTERNA-870] N87-21595
ELECTRONS
The production of weak intermediate bosons in electron-positron reactions [PREPRINT-520] N87-21667
ELECTROPHOTOMETRY
Activities report in electrical technology [ETN-87-99354] N87-21253
ELECTROPHYSICS
Basic research in electronics: Joint Services Electronics Program (JSEP) [AD-A177067] N87-21247
ELECTROSTATIC ENGINES
Precision tunable resonant microwave cavity [NASA-CASE-LEW-13935-1] N87-21234
ELECTROSTATIC WAVES
The effect of beam-driven return current instability on solar hard X-ray bursts N87-21820
ELECTROSTATICS
Cluster beam studies [AD-A176803] N87-21163
A 1-ms electron beam facility for laser kinetic studies [DE87-003299] N87-21323
ELEMENTARY PARTICLE INTERACTIONS
Joint production of phi mesons and pi(+,-), pi(0), rho, rho bar, K(0)S and K(+,-) in hadronic interactions [NIKHEF-H/86-2] N87-21663
ELEVATION
The representation of the Earth's gravitational potential in a spherical harmonic expansion to degree 250 [AD-A176479] N87-21431
A method for the construction of continuously differentiable surfaces for the interpolation of scattered data [HMI-B371] N87-21628
ELLIPSOIDS
Ellipsoidal corrections to potential coefficients obtained from gravity anomaly data on the ellipsoid [AD-A176901] N87-21435
EMBOLISMS
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness [AD-A176558] N87-21556
EMBRITTLEMENT
Stress corrosion cracking and metal-induced embrittlement: Comparative studies of local chemistries [DE87-004300] N87-21097
EMERGENCIES
A theoretical examination of a reentry capsule incorporating an autorotating rotor [AD-A176854] N87-21026
EMERGENCY LIFE SUSTAINING SYSTEMS
Personnel emergency carrier vehicle [NASA-CASE-KSC-11282-1] N87-21755
EMISSION
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere [DE87-003600] N87-21438
EMISSION SPECTRA
The 2-4 semiconductor superlattices [AD-A177092] N87-21696
A CO survey of the dark nebulae in Taurus and Perseus N87-21760
ENCLOSURES
Numerical simulation of buoyant convection in vented enclosures [DE86-012941] N87-21280
ENERGY ABSORPTION
Experimental and theoretical studies of laser propulsion phenomenology [AD-A176851] N87-21315
ENERGY BUDGETS
Vorticity budgets for Alpine cyclogenesis with and without the forcing of terrain N87-21508
ENERGY CONVERSION EFFICIENCY
Multicomponent flow compressor: A new concept for efficient energy conversion [DE87-004011] N87-21278
Bidirectional control system for energy flow in solar powered flywheel [NASA-CASE-MFS-25078-1] N87-21410
High efficiency crystalline silicon solar cells [NASA-CR-180530] N87-21411
Computer modeling of high intensity solar cells [DE87-005970] N87-21416
ENERGY DISSIPATION
Acoustic-mean flow interactions [AD-A176845] N87-21038
The hard X-ray to low energy Gamma-Ray spectrum of the crab nebula N87-21761
ENERGY DISTRIBUTION
Evidence for beamed electrons in a limb X-ray flare observed by Hard X-Ray Imaging Spectrometer (HXIS) N87-21791
A study of starting time in great hard X-ray flares N87-21792
Statistical analysis of fast hard X-ray bursts by SMM observations and microwave bursts by ground-based observations N87-21793
Microwave and hard X-ray emissions during the impulsive phase of solar flares: Nonthermal electron spectrum and time delay N87-21794
Hard X-ray imaging observation of fluctuating bursts N87-21795
ENERGY GAPS (SOLID STATE)
Superlattice effects in graphite intercalation compounds [AD-A176879] N87-21694
ENERGY LEVELS
A third class of high energy burster [DE87-006051] N87-21841

ENERGY SPECTRA
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432
Signatures of current loop coalescence in solar flares N87-21827
ENERGY TRANSFER
Three dimensional dynamical and chemical modelling of the upper atmosphere
[NASA-CR-180514] N87-21428
Fast fluctuations of soft X-rays from active regions N87-21797
Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares N87-21805
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810
A search for fast variations in the Fe XXI emission during solar flares N87-21811
OV and hard X-rays, observations and model calculations N87-21814
Rapid soft X-ray fluctuations in solar flares observed with the X-ray polychromator N87-21815
Thermal waves or beam heating in the 1980, November 5 flare N87-21828
ENGINE ANALYZERS
High response data acquisition system N87-21189
ENGINE CONTROL
Some considerations relating to aero engine pyrometry N87-21187
ENGINE DESIGN
Aircraft and engine development testing
[AD-A176711] N87-20961
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039
Introduction and status of the ceramic technology for advanced heat engines project
[DE87-004403] N87-21122
ENGINE FAILURE
Airplane automatic control force trimming device for asymmetric engine failures
[NASA-CASE-LAR-13280-1] N87-20999
ENGINE NOISE
Some aspects of fan noise generation in axial compressors
[NLR-MP-85089-U] N87-21657
ENGINE PARTS
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
Interferometric measurement of strains and displacements in engine components N87-21196
ENGINE TESTING LABORATORIES
Hover performance of a remotely piloted helicopter
[AD-A176587] N87-20992
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
ENGINE TESTS
Aircraft and engine development testing
[AD-A176711] N87-20961
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
ENTHALPY
High-temperature relative enthalpies of V2O5: Report of investigations/1986
[PB87-140737] N87-21733
ENTRAINMENT
Mixing in a double-diffusive, partially stratified fluid
[DE87-001131] N87-21285
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 4: Study of entrainment mechanisms using simulations and experimental results
[ETN-87-99397] N87-21296
ENVIRONMENT EFFECTS
Environmental-physical measurements and determination of atmospheric turbulence with the ASK-16 motor glider N87-21460
ENVIRONMENT MODELS
Thunderstorm influence on boundary layer winds
[AD-A176543] N87-21518
ENVIRONMENTAL LABORATORIES
Hover performance of a remotely piloted helicopter
[AD-A176587] N87-20992
ENVIRONMENTAL MONITORING
Report to the Congress on ocean pollution, monitoring and research, October 1984 through September 1985
[PB87-129425] N87-21420
EWAM: A model for predicting food and water ingestion, and inhalation rates of man
[DE86-900117] N87-21590
ENVIRONMENTS
Inhibition of localized corrosion
[AD-A176573] N87-21083
EPHEMERIDES
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985
EPOXY COMPOUNDS
Network polymers formed under nonideal conditions
[AD-A176406] N87-21115
EPOXY MATRIX COMPOSITES
Contribution to the study of the epoxy-glass interfaces in glass fiber reinforced composites
[ECL-86-10] N87-21055
EPOXY RESINS
Ultrasonic cure characterization of epoxy resins: Constitutive modeling
[AD-A176661] N87-21116
Fabrication of open cell epoxy foam
[DE87-006166] N87-21125
EQUALIZERS (CIRCUITS)
Results and analysis of static and dynamic multipath in a severe atmospheric environment
[PB87-131165] N87-21231
EQUATIONS OF MOTION
Vortex motion in a stratified medium
[AD-A176729] N87-21289
EQUATIONS OF STATE
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
State equation of condensed materials: Physical principles and applications
[ECL-86-15] N87-21069
EQUIPMENT SPECIFICATIONS
Mars Observer: Phase 0 safety review data package
[NASA-CR-180526] N87-21019
Impulsive phase solar flare X-ray polarimetry N87-21789
The physical origins of the cosmic ultraviolet background N87-21840
EQUIVALENT CIRCUITS
Macromodeling of digital circuits
[AD-A176874] N87-21243
ERROR ANALYSIS
Task execution control in assembly robot workcells
[LAAS-86-335] N87-21356
Accuracy and error analysis — flight test measurement errors N87-21468
A modeling and simulation tool for fault-tolerant distributed systems applied to distributed database management systems
[KFK-4138] N87-21614
ERROR CORRECTING CODES
Reed-Solomon decoder
[NASA-CASE-NPO-15982-1] N87-21591
The binary weight distribution of the extended (2 sup m, 2 sup m-4) code of Reed-Solomon code over GF(2 sup m) with generator polynomial (x-alpha sup 2) (x-alpha sup 3)
[NASA-CR-180510] N87-21625
ERROR SIGNALS
Comparator with noise suppression
[NASA-CASE-LAR-13151-1] N87-21235
ERS-1 (ESA SATELLITE)
Testing of the advanced microwave instrument for the European Remote Sensing Satellite ERS-1
[ETN-87-99477] N87-21409
ESCHERICHIA
Direct and indirect effects of stationary magnetic field on biological systems N87-21574
Radiosensitivity of escherichia coli following irradiation in a stationary magnetic field N87-21582
ESTIMATES
Cosmic ray effects on microelectronics. Part 4
[AD-A176611] N87-21242
ETCHING
Ion beam sputter etching
[NASA-CASE-LEW-13809-1] N87-21160
Field assisted etching
[RSRE-MEMO-3715] N87-21161
Methods for thinning silicon chips
[RSRE-MEMO-3952] N87-21162
EVALUATION
Approach to evaluating leak detection methods in underground storage tanks
[PB87-118444] N87-21168
An agenda for improved evaluation of supercomputer performance
[DE87-005698] N87-21593
Agenda for improved evaluation of supercomputer performance
[PB87-137196] N87-21596
EVAPORATION
Laser evaporation studies
[AD-A176826] N87-21313
EVOLUTION (DEVELOPMENT)
Collisional evolution in the asteroid belt: An observational and numerical study N87-21768
EXAMINATION
Objective testing for the pilot's instrument rating. Specimen examination material: Flight planning and navigation procedures, flight instruments and radio aids, meteorology, aviation law, flight rules and procedures
[CAP-519] N87-21583
EXCIMER LASERS
Short wavelength laser/materials interactions
[AD-A176950] N87-21316
Pulsed excimer laser processing for cost-effective solar cells
[NASA-CR-180528] N87-21413
EXOBIOLOGY
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 297)
[NASA-SP-7011(297)] N87-21552
EXPANSION
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions
[NASA-CR-180272] N87-21303
The representation of the Earth's gravitational potential in a spherical harmonic expansion to degree 250
[AD-A176479] N87-21431
Inflation in the universe, Circa 1986
[DE87-005399] N87-21778
EXPEDITIONS
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535
EXPERIMENT DESIGN
Preparation and characterization of potassium hydroaluminates KAlH4, K3AlH6, K2NaAlH6, K3AlH4F2
[INSA-IDTC1-8602] N87-21067
Cryogenic Fluid Management Flight Experiment (CFMFE) N87-21150
Space experiment development process N87-21156
Shuttle middeck fluid transfer experiment: Lessons learned N87-21158
The observational objectives and the implementation of the Global Weather Experiment N87-21474
The aim and conduct of ALPEX — Alpine Experiment (ALPEX) N87-21486
Light gluinos and fixed target experiments
[PREPRINT-526] N87-21668
EXPERT SYSTEMS
A real-time expert system for control of an autonomous mobile robot and for diagnosing unexpected occurrences
[DE87-002411] N87-21345
Real-time expert system for the control of autonomous robot navigation in the presence of moving obstacles
[DE87-002167] N87-21350
Real-time expert system for control of an autonomous mobile robot including diagnosis of unexpected occurrences
[DE87-000385] N87-21354
Artificial intelligence techniques for working with knowledge
[NLR-MP-85037-U] N87-21621
Providing knowledge by means of artificial intelligence techniques: Experiences and developments at the National Aerospace Laboratory (NLR)
[NLR-MP-85081-U] N87-21622
EXPLODING WIRES
A solid state triggered switch for EBW firing circuits — exploding bridge wire (EBW)
[RARDE-MEMO-6/86] N87-21236
EXPLOSIONS
A self-similar approach to the explosion of droplets by a high energy laser beam
[DE87-005124] N87-21322
Theoretical and observational review of results on nova explosions occurring on ONeMg white dwarfs
[DE87-001982] N87-21772
EXPLOSIVE FORMING
Microstructural response of rapidly solidified 304 stainless steel powder to three consolidation techniques
[DE87-000439] N87-21100
EXPLOSIVES
Energetic materials for military purposes: An assessment
[PB87-137220] N87-21138
EXPONENTIAL FUNCTIONS
Some research problems in reliability theory and in limit theory
[AD-A176439] N87-21363

EXPONENTS
The relevance of connectance on the Lyapunov characteristic exponents of products of symplectic random matrices
[PREPRINT-519] N87-21643
EXTERNAL TANKS
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 1
[NASA-CR-179074] N87-21012
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 3
[NASA-CR-179076] N87-21013
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 2
[NASA-CR-179075] N87-21014
Filament wound data base development, revision 1, appendix A
[NASA-CR-179069] N87-21015
EXTREME ULTRAVIOLET RADIATION
Fast temporal correlation between hard X-ray and ultraviolet continuum brightenings N87-21812
EXTRUDING
Microstructural response of rapidly solidified 304 stainless steel powder to three consolidation techniques
[DE87-000439] N87-21100
EYE MOVEMENTS
Thresholds of long-latency-period potentials and sensation of motion evoked in man by linear accelerations N87-21571

F

F REGION
Model results with PIE (Polar Ionospheric Irregularities Experiment) rocket data
[AD-A176999] N87-21436
FABRICATION
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Processing and properties of powder metallurgy Ni(sub 3)Al-Cr-Zr-B for use in oxidizing environments
[DE87-001699] N87-21101
Cluster beam studies
[AD-A176803] N87-21163
Development of the diffusion bonding process
[DE87-006599] N87-21164
Laser microfabrication technology and its application to high speed interconnect of gate arrays
[DE87-004363] N87-21320
High efficiency crystalline silicon solar cells
[NASA-CR-180530] N87-21411
Large area sheet task: Advanced dendritic web growth development
[NASA-CR-180505] N87-21417
Vortices in long Josephson junctions
[AD-A176916] N87-21695
Characterization of on-chip polycrystalline silicon photoconductors
[DE87-003745] N87-21705
Artificially structured superconductors
[DE87-004007] N87-21714
FABRICS
Comparison of the toxicity of the combustion products from a flexible polyurethane foam and a polyester fabric evaluated separately and together by the NBS (National Bureau of Standards) toxicity test method and a cone radiant heater toxicity test apparatus
[PB87-140265] N87-21169
FABRY-PEROT INTERFEROMETERS
Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility N87-21183
FAILURE
Multi-axial failure criteria in fiber composites and their application to the through-thickness strength of hybrid fiber laminates N87-21040
Comparison between calculated and measured forward and reverse current-voltage characteristics
[AD-A176607] N87-21241
FAILURE ANALYSIS
Resistance curve approach to predicting residual strength of composites
[AD-A176984] N87-21050
FAST FOURIER TRANSFORMATIONS
The flow around a squared obstacle N87-21185
FAST NUCLEAR REACTORS
Advanced B and Al combustion kinetics studies over wide temperature ranges
[AD-A176626] N87-21061
FATIGUE (MATERIALS)
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387
FATIGUE LIFE
Improvement of fatigue life prediction accuracy for various realistic loading spectra by use of correction factors
[TAE-581] N87-21374
FATIGUE TESTS
Analysis of vibration data from WHL (Westland Helicopters Limited) Wessex fatigue test trial 3
[AD-A176208] N87-21003
A comparison of the fatigue performance of woven and non-woven CFRP laminates
[RAE-TR-85059] N87-21041
The micromechanics of damage initiation and development under static and fatigue loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99985] N87-21044
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387
Fatigue crack growth under cyclic compression: Role of first load cycle
[FFA-TN-1986-71] N87-21398
FAULT TOLERANCE
Fault-tolerant system analysis: Imperfect switching and maintenance
[AD-A176514] N87-20995
Fault tolerant electrical power system. Phase 1: Study
[AD-A177061-PH-1] N87-21246
A modeling and simulation tool for fault-tolerant distributed systems applied to distributed database management systems
[KFK-4138] N87-21614
FEASIBILITY ANALYSIS
Analysis of the feasibility of silicon on insulator submicron CMOS technology
[ECL-86-07] N87-21716
FEEDBACK
A simple method for electronic feedback stabilization of an actively modelocked and Q-switched Nd:YLF laser
[DE87-002623] N87-21325
FEEDBACK CONTROL
Ultrasonic detection of weld bead geometry
[DE87-000441] N87-21366
Quantitative Feedback Theory (QFT): Technique for designing multivariable control systems
[AD-A176883] N87-21617
FERMI LIQUIDS
Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems
[PREPRINT-542] N87-21674
FERMIONS
The octet nonleptonic Hamiltonian and current algebra on the lattice with Wilson fermions
[PREPRINT-525] N87-21636
FERRITIC STAINLESS STEELS
Effect of grain boundary structure on sensitization and corrosion of stainless steel
[AD-A176299] N87-21081
FERROELECTRICITY
Lead titanates: Electromechanical anisotropic materials applicable to electroacoustic instrumentation
[INSA-IDI1-8603] N87-21068
FIBER OPTICS
Fiber glass pulling — in space
[NASA-CR-179036] N87-21140
Sapphire fiber optic temperature probe N87-21186
Amplitude-independent fiber-optic pressure sensor
[DE87-003673] N87-21682
Liquid-core fiber optics: Transmission and nonlinear effects
[DE87-005960] N87-21683
FIBER REINFORCED COMPOSITES
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: An initial study
[NASA-TM-89846] N87-21043
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048
Polydiacetylene single crystal fibres and their use in fibre-reinforced composites
[AD-A176927] N87-21049
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Part A: Adhesion and delamination
[ETN-87-99576] N87-21056
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination
[ETN-87-99577] N87-21057
FIBERS
Polydiacetylene single crystal fibres and their use in fibre-reinforced composites
[AD-A176927] N87-21049
FIELD EFFECT TRANSISTORS
Contribution to understanding and modeling hot carrier injection phenomena in submicron MOS devices
[ECL-86-12] N87-21717
Activities report in aerospace sciences
[ETN-87-99369] N87-21845
FIELD THEORY (PHYSICS)
The gauge field copies and Backlund transformation
[PREPRINT-513] N87-21632
Multiplet calculus and compensating fields in D = 2 conformal supergravity
[NIKHEF-H/86-11] N87-21726
Gauge fixing for the field theory of the basonic string
[PREPRINT-527] N87-21729
FILAMENT WINDING
Filament wound data base development, revision 1, appendix A
[NASA-CR-179069] N87-21015
Filament wound data base development, revision 1
[NASA-CR-179068-REV-1] N87-21016
Filament wound data base development, revision 1, appendix B
[NASA-CR-179070] N87-21017
FILTRATION
Techniques to determine particulates in liquid fuels
[DE87-002028] N87-21135
FINE STRUCTURE
Supermultiplets in Hilbert space for the supersymmetric bag model
[NIKHEF-H/86-5] N87-21664
Multiplet calculus and compensating fields in D = 2 conformal supergravity
[NIKHEF-H/86-11] N87-21726
FINES
Mechanical properties of elementally blended Ti-6Al-4V
[AD-A176640] N87-21086
FINITE DIFFERENCE THEORY
Algorithm implementation on the Navier-Stokes computer
[NASA-TM-89119] N87-20968
An approach to practical aerodynamic calculations
[AD-A176995] N87-20970
Vortex motion in a stratified medium
[AD-A176729] N87-21269
Numerical simulation of compressible Navier-Stokes flow in a double throat nozzle
[AD-A177023] N87-21271
Adaptive finite difference methods in fluid dynamics
[DE87-004690] N87-21298
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions
[NASA-CR-180272] N87-21303
FINITE ELEMENT METHOD
OPUS: Optimal Projection for Uncertain Systems
[AD-A176820] N87-21025
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21282
Summary of the modeling and test correlations of a NASTRAN finite element vibrations model for the AH-1G helicopter, task 1
[NASA-CR-178201] N87-21373
Convergence of strain energy release rate components for edge-delaminated composite laminates
[NASA-TM-89135] N87-21377
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384
Identification of material constants for a composite shell structure
[DE87-004524] N87-21395
Self-adaptive Finite Element (FE) analysis of solid structures. Part 1: Element formulation and a posteriori error estimation
[FFA-TN-1986-27] N87-21400
Finite element analysis of three-dimensional structures using adaptive p-extensions
[FFA-TN-1986-57] N87-21401
FINS
Prediction of the aerodynamic characteristics of cruciform missiles including effects of roll angle and control deflection
[AD-A176553] N87-21010

FIRE CONTROL
Automation strategy for a Royal Netherlands Air Force (RNLAF) air base command and control information system
[NLR-MP-85070] N87-21743
FIRES
Numerical simulation of buoyant convection in vented enclosures
[DE86-012941] N87-21280
FISHERIES
Marine environmental assessment: Chesapeake Bay, December 1985 - February 1986
[PB87-129458] N87-21531
FISSIUM
Behavior of UO2 and fissium in sodium vapor atmosphere at temperatures up to 2800 C — reactor core disassembly
[KFK-4135] N87-21677
FITTINGS
Self indexing latch system
[NASA-CASE-MFS-25956-1] N87-21333
FLAME PROPAGATION
On the aerodynamics of flames N87-21058
Turbulent premixed flame study
[DE87-006255] N87-21066
Size and shape of solid fuel diffusion flames in very low speed flows
[NASA-CR-179576] N87-21129
The study of combustion by means of diode laser spectroscopy N87-21201
FLAME SPECTROSCOPY
Accurate measurements of combustion species concentrations using CARS N87-21173
FLAMES
Accurate measurements of combustion species concentrations using CARS N87-21173
FLAMMABILITY
Prediction of fire properties of materials. Part 1: Aliphatic and aromatic hydrocarbons and related polymers
[PB87-140240] N87-21072
FLAT PLATES
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer
[NASA-CR-4052] N87-21257
FLEXIBILITY
Aileron reversal of swept wings with crossflexibilities
[RAE-TR-83023] N87-20988
Divergence and flutter of swept-forward wings with crossflexibilities
[RAE-TR-80047] N87-21000
Comparison of the toxicity of the combustion products from a flexible polyurethane foam and a polyester fabric evaluated separately and together by the NBS (National Bureau of Standards) toxicity test method and a cone radiant heater toxicity test apparatus
[PB87-140265] N87-21169
FLEXIBLE BODIES
Modeling and experimental validation of a single-link flexible manipulator
[AD-A176614] N87-21336
A NASTRAN primer for the analysis of rotating flexible blades
[NASA-TM-89661] N87-21375
Modeling and control of flexible structures
[AD-A177106] N87-21388
FLEXIBLE SPACECRAFT
OPUS: Optimal Projection for Uncertain Systems
[AD-A176820] N87-21025
Dynamics of flexible structures performing large overall motions: A geometrically-nonlinear approach N87-21335
FLIGHT CHARACTERISTICS
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 1
[NASA-CR-179074] N87-21012
Orbital flight test shuttle external tar.k aerothermal flight evaluation, volume 3
[NASA-CR-179076] N87-21013
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 2
[NASA-CR-179075] N87-21014
Determination of vertical air velocity using measurements of the aircraft motion N87-21456
A comparison between Falcon data and motor glider data N87-21458
Development and operation of a measuring data acquisition system for use in flight airplanes N87-21467
FLIGHT CONTROL
Wing divergence and structural distortion
[RAE-TR-85057] N87-20989
Advanced Electromechanical Actuation System (EMAS), flight test
[AD-A176148] N87-21001
State constraints for predictive control with air vehicle application
[AD-A176205] N87-21002
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
Prediction of the aerodynamic characteristics of cruciform missiles including effects of roll angle and control deflection
[AD-A176553] N87-21010
OPUS: Optimal Projection for Uncertain Systems
[AD-A176820] N87-21025
FLIGHT CREWS
Human factors research in aircrew performance and training
[AD-A176099] N87-21586
Theoretical development for identifying underlying internal processes. Volume 1. The theory of underlying internal processes
[AD-A176466] N87-21588
FLIGHT INSTRUMENTS
Ground Proximity Warning System (GPWS): Guidance material
[CAP-516] N87-20977
Electronic display equipment for use in the advanced flight deck simulator at British Aerospace, Weybridge
[RID-1912] N87-21005
FLIGHT MECHANICS
Influencing variables in the assessment of vertical wind velocity by means of flight-mechanics equations N87-21457
FLIGHT PLANS
Extended Range Twin Operations (ETOPS) — twin engined aircraft
[CAP-513] N87-20976
The application of Computer Aided Design (CAD) techniques in a route-planning system
[NLR-MP-85039-U] N87-21605
FLIGHT SAFETY
Ground Proximity Warning System (GPWS): Guidance material
[CAP-516] N87-20977
FLIGHT SIMULATORS
Electronic display equipment for use in the advanced flight deck simulator at British Aerospace, Weybridge
[RID-1912] N87-21005
Human factors research in aircrew performance and training
[AD-A176099] N87-21586
FLIGHT TESTS
Challenges in modeling the X-29 flight test performance
[NASA-TM-88262] N87-20991
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 1
[NASA-CR-179074] N87-21012
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 3
[NASA-CR-179076] N87-21013
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 2
[NASA-CR-179075] N87-21014
A comparison between Falcon data and motor glider data N87-21458
Accuracy and error analysis — flight test measurement errors N87-21468
FLOW CHARACTERISTICS
Acoustic-mean flow interactions
[AD-A176845] N87-21038
FLOW COEFFICIENTS
Flow properties of He3 in dilute He3-He4 mixtures at temperatures between 10 and 150 mK
[ETN-87-99582] N87-21300
FLOW DEFLECTION
Prediction of the aerodynamic characteristics of cruciform missiles including effects of roll angle and control deflection
[AD-A176553] N87-21010
FLOW DISTRIBUTION
Laser Doppler velocimeter measurements in a turbulent junction vortex N87-20964
Experimental studies on the dynamic development and control of unsteady separated flows
[AD-A176376] N87-20969
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039
Laser fringe anemometry for aero engine components N87-21176
Laser-2 focus velocimetry N87-21177
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer
[NASA-CR-4052] N87-21257
Viscous flow around wall mounted obstacles
[ARL-AERO-PROP-REPT-172] N87-21260
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262
Convectively driven superfluid turbulence in dilute solutions of He3 in superfluid He4
[DE87-002918] N87-21275
Heat transfer in oscillatory flow
[DE87-004374] N87-21276
Activities report in fluid mechanics
[ETN-87-99370] N87-21288
Diesel engine combustion program at the Defence Research Establishment Ottawa
[AD-A176438] N87-21336
FLOW EQUATIONS
An approach to practical aerodynamic calculations
[AD-A176995] N87-20970
Activities report in aerodynamics
[ETN-87-99372] N87-20973
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176548] N87-21264
FLOW MEASUREMENT
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
Laser fringe anemometry for aero engine components N87-21176
Laser-2 focus velocimetry N87-21177
How to select a laser velocimeter for a given application? N87-21179
Application of Doppler and transit laser anemometry in small turbomachines N87-21180
Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor N87-21181
Evaluation of L2F-measurements in unsteady turbine flow N87-21182
Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility N87-21183
The flow around a squared obstacle N87-21185
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
Processing techniques for correlation of LDA and thermocouple signals N87-21194
The utilization of thin film sensors for measurements in turbomachinery N87-21195
The application of holography as a transonic flow diagnostic to rotating components in turbomachinery N87-21202
Beam-modulation methods in quantitative and flow-visualization holographic interferometry N87-21204
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer
[NASA-CR-4052] N87-21257
A laser Doppler method for noninvasive measurement of flow velocity
[DE87-005197] N87-21283
Study of various holographic assemblies to observe particles smaller than diffraction length, in flows with or without density gradients
[IMFL-86/21] N87-21309
Vertical air motion and turbulence parameters from commercial aircraft N87-21494
FLOW STABILITY
Acoustic-mean flow interactions
[AD-A176845] N87-21038
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341
FLOW THEORY
Activities report in aerodynamics
[ETN-87-99372] N87-20973
FLOW VELOCITY
Laser Doppler velocimeter measurements in a turbulent junction vortex N87-20964
Size and shape of solid fuel diffusion flames in very low speed flows
[NASA-CR-179576] N87-21129
Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility N87-21183
A laser Doppler method for noninvasive measurement of flow velocity
[DE87-005197] N87-21283
Use of laser-Doppler-anemometry for the measurement of velocity distributions at the intake of a longitudinal flow heat exchanger
[JUEL-SPEZ-362] N87-21293
FLOW VISUALIZATION
In-flight surface oil-flow photographs with comparisons to pressure distribution and boundary-layer data
[NASA-TP-2395] N87-20966
Digital image processing applied to fluid dynamic problems N87-21193
The application of holography as a transonic flow diagnostic to rotating components in turbomachinery N87-21202

A study of passage flow through a cascade of turbine blades using image plane holographic interferometry N87-21203
Beam-modulation methods in quantitative and flow-visualization holographic interferometry N87-21204
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
Transonic compressor blade tip flow visualization on a water table
[AD-A176592] N87-21265
Study of various holographic assemblies to observe particles smaller than diffraction length, in flows with or without density gradients
[IMFL-86/21] N87-21309
Diesel engine combustion program at the Defence Research Establishment Ottawa
[AD-A176436] N87-21336
Laboratory simulation of rotating stratified flow over and around the Alps N87-21516

FLUCTUATION THEORY
Fluctuations in membranes with crystalline and hexatic order
[PREPRINT-538] N87-21402

FLUID DYNAMICS
Computer code for gas-liquid two-phase vortex motions: GLVM
[NASA-CR-180265] N87-21139
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
Digital image processing applied to fluid dynamic problems N87-21193
Transonic compressor blade tip flow visualization on a water table
[AD-A176592] N87-21265
Wake interaction effects on the transition process on turbine blades
[AD-A177094] N87-21272
Geophysical Fluid Dynamics Laboratory activities FY86, plans FY87
[PB87-134458] N87-21403

FLUID FLOW
A spatial marching technique for the inviscid blunt body problem
[DE87-004526] N87-20972
Digital image processing applied to fluid dynamic problems N87-21193
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262
Flow induction by rotary jets
[AD-A177013] N87-21270
Alternative flow control nozzles/energy dissipation of highly erosive fluids
[DE87-001025] N87-21273
A laser Doppler method for noninvasive measurement of flow velocity
[DE87-005197] N87-21283
Dual motion valve with single motion input
[NASA-CASE-MFS-28058-1] N87-21332

FLUID JETS
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE87-004004] N87-21065

FLUID MANAGEMENT
Microgravity Fluid Management Symposium
[NASA-CP-2465] N87-21141
Advanced long term cryogenic storage systems N87-21142
Long term cryogenic storage facility systems study N87-21143
Space station experiment definition: Long term cryogenic fluid storage N87-21144
Helium technology issues N87-21145
Overview: Fluid acquisition and transfer N87-21146
The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement N87-21147
Numerical modelling of cryogenic propellant behavior in low-G N87-21148
Mixing-induced fluid destratification and ullage condensation N87-21149
Cryogenic Fluid Management Flight Experiment (CFMFE) N87-21150
Superfluid helium on orbit transfer (SHOOT) N87-21151
Microgravity fluid management in two-phase thermal systems N87-21152
Microgravity fluid management requirements of advanced solar dynamic power systems N87-21153
Maintenance evaluation for space station liquid systems N87-21155
Shuttle middeck fluid transfer experiment: Lessons learned N87-21158

FLUID MECHANICS
A spatial marching technique for the inviscid blunt body problem
[DE87-004526] N87-20972
Turbulent energy generated by accelerations and shocks
[DE87-002377] N87-21274
Viscosity behavior in supercooled pure liquids and mixtures
[DE87-004036] N87-21282
Activities report in fluid mechanics
[ETN-87-99370] N87-21288

FLUORESCENCE
Laser light-scattering and laser fluorescence studies of solvent extraction systems
[DE87-003910] N87-21321
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176269] N87-21535

FLUOROCARBONS
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere
[DE87-003600] N87-21438

FLUOROSCOPY
The application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce N87-21196

FLUTTER ANALYSIS
Divergence and flutter of swept-forward wings with crossflexibilities
[RAE-TR-86047] N87-21000

FLUX DENSITY
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039

FLYWHEELS
Bidirectional control system for energy flow in solar powered flywheel
[NASA-CASE-MFS-25978-1] N87-21410

FOAMS
Fabrication of open cell epoxy foam
[DE87-006186] N87-21125
Handbook for using foams to control vapors from hazardous spills
[PB87-145660] N87-21421

FOCUSING
Ultrasonic NDE of green-state ceramic using focused through-transmission
[DE87-001494] N87-21367

FOOD INTAKE
EWAM: A model for predicting food and water ingestion, and inhalation rates of man
[DE86-900117] N87-21590

FORECASTING
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA21, 7-20 July 1986
[AD-A176638] N87-21541
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986
[AD-A176639] N87-21542

FORGING
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California
[AD-A176509] N87-20958

FORTRAN
STARPAC: The standard times series and regression package
[PB87-152385] N87-21641

FRACTALS
Intermittancy as multifractality in history space
[PREPRINT-518] N87-21639
The multifractal nature of strange attractors and turbulence
[PREPRINT-539] N87-21640

FRACTURE MECHANICS
The micromechanics of damage initiation and development under static and fatique loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99985] N87-21044
Fracture and hardness of semiconductor alloys
[AD-A176800] N87-21088
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
Fracture properties of ferritic, ferritic-pearlitic, pearlitic and bainitic nodular cast irons
[VTT-430] N87-21110
Activities report in structures
[ETN-87-99375] N87-21166
Convergence of strain energy release rate components for edge-delaminated composite laminates
[NASA-TM-89135] N87-21377
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382
Elastic interactions of a crack with damage and associated energy release rates
[AD-A177071] N87-21385

FRACTURE STRENGTH
Effects of irradiation on the fracture toughness of Alloy 718 plate and weld
[DE87-004345] N87-21102
Fracture properties of ferritic, ferritic-pearlitic, pearlitic and bainitic nodular cast irons
[VTT-430] N87-21110

FRACTURES (MATERIALS)
Fundamentals of hardening and decohesion behavior in time-dependent cycle deformation
[DE87-003995] N87-21091
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378

FRACTURING
Ductile fracture and random versus regular hole/void arrays
[AD-A176627] N87-21085
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382

FREE ELECTRON LASERS
Short wavelength laser/materials interactions
[AD-A176950] N87-21316
Multifacet, metal mirror design for extreme-ultraviolet and soft X-ray free-electron laser resonators
[DE87-005100] N87-21328
An Overview of the Lawrence Livermore National Laboratory Free Electron Laser Program
[DE87-005815] N87-21330
Induction linear accelerator technology for SDIO applications
[DE87-003251] N87-21642

FREE-PISTON ENGINES
A 1987 overview of free-piston Stirling technology for space power application
[NASA-TM-89832] N87-21756

FREQUENCY ASSIGNMENT
Calculation of power-flux density levels in the 2 GHz band, phase three
[PB87-120523] N87-21230

FREQUENCY CONTROL
Modeling and control of flexible structures
[AD-A177106] N87-21388

FREQUENCY MEASUREMENT
Measurement of dielectric properties of minerals at microwave frequencies, report of investigations 1986
[PB87-116968] N87-21723

FREQUENCY MODULATION
Beam-modulation methods in quantitative and flow-visualization holographic interferometry N87-21204

FREQUENCY RESPONSE
Multi-point transient modal testing
[DE87-003880] N87-21394

FREQUENCY STABILITY
Low phase noise oscillator using two parallel connected amplifiers
[NASA-CASE-GSC-13018-1] N87-21232

FREQUENCY STANDARDS
Calculation of power-flux density levels in the 2 GHz band, phase three
[PB87-120523] N87-21230

FREQUENCY SYNCHRONIZATION
The fundamentals of timing and synchronization for digital communication networks
[AD-A176721] N87-21220

FRETTING
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387

FRETTING CORROSION
Wear induced by small amplitude vibrations: Phenomena identification
[ECL-86-11] N87-21359

FRICTION
Mathematical and numerical study of a single side contact friction problem in elasticity and elastoplasticity
[ECL-85-09] N87-21356

FRICTION DRAG
Spanish Limited Area Model (LAM) behavior in two cases of Mediterranean cyclogenesis N87-21502

Representation of pressure drag effects in numerical modeling of Alpine cyclogenesis N87-21503

FRICTION WELDING
Inertia friction welding of 1100 aluminum to type 316 stainless steel
[DE87-005044] N87-21347

FUEL CELLS
Corrosion resistant materials in MCFC environment
[DE87-004199] N87-21414

FUEL COMBUSTION
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
CARS thermometry for low and high pressure combustion systems N87-21172
Accurate measurements of combustion species concentrations using CARS N87-21173

FUEL INJECTION
Diesel engine combustion program at the Defence Research Establishment Ottawa
[AD-A176438] N87-21336

FUEL TANKS
Space station experiment definition: Long term cryogenic fluid storage N87-21144

FUEL-AIR RATIO
Velocity and temperature measurements in a can-type gas-turbine combustor N87-21184

FUNCTION SPACE
A class of integral transforms and associated function spaces
[ETN-87-99575] N87-21629

FUNCTIONS (MATHEMATICS)
Some research problems in reliability theory and in limit theory
[AD-A176439] N87-21363
NILFIT: An interactive system for nonlinear fit of data
[HMI-B431] N87-21607
On learning boolean functions
[AD-A176516] N87-21626

FURNACES
Fiber glass pulling — in space
[NASA-CR-179036] N87-21140

G

GALILEO PROJECT
Reed-Solomon decoder
[NASA-CASE-NPO-15982-1] N87-21591

GALLIUM ARSENIDES
Ellipsometric and photoluminescent characterization of H2 and N2 multipolar plasma interactions with the 100 GaAs crystal surface
[INSA-IDI-186-05] N87-21687
Application of the ALE and MBE methods to the growth of layered Hg sub 1-x Cd sub x Te films
[AD-A176797] N87-21692
GaAs photoconductors to characterize picosecond response in GaAs integrated devices and circuits
[DE87-003744] N87-21704
Investigations on the MBE growth and properties of Al/(y)/Ga/(y)/In/(1-x-y/As/InP) and InAlAs superlattices
[DE87-005190] N87-21709
Transport properties of GaAs. Contribution to the study of GaAs/(Ca,Sr)F2 structures using molecular beam epitaxy
[LAAS-86-330] N87-21718

GAMMA RAY ASTRONOMY
Very high energy gamma ray astrophysics
[DE87-006293] N87-21842

GAMMA RAY BURSTS
The propagation of solar flare particles in a coronal loop N87-21826
A third class of high energy burster
[DE87-006051] N87-21841

GAMMA RAY SPECTRA
The hard X-ray to low energy Gamma-Ray spectrum of the crab nebula N87-21761

GAMMA RAYS
Very high energy gamma ray astrophysics
[DE87-006293] N87-21842

GAS ANALYSIS
Development of chemical sensors: Empirical art or systematic research?
[DRIC-T-7783] N87-21059

GAS DENSITY
Vorticity generation by shock propagation through bubbles in air
[AD-A176610] N87-21266

GAS DETECTORS
Laser microprobe studies of rare gas isotopes in meteorites N87-21789

GAS DISSOCIATION
Derivation of working equations of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte with consideration of extracted oxygen N87-21575
Calculation of equilibrated concentrations of constituents of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte and corresponding values of theoretical voltage of dissociation N87-21576

GAS FLOW
Seeding gas flows for laser anemometry N87-21178
Numerical simulation of compressible Navier-Stokes flow in a double throat nozzle
[AD-A177023] N87-21271
Multicomponent flow compressor: A new concept for efficient energy conversion
[DE87-004011] N87-21278
Low noise lead screw positioner
[NASA-CASE-NPO-15617-1] N87-21304

GAS GENERATORS
A solid propellant charge design with negative effective pressure exponent using forced cone burning
[WSRL-0469-TR] N87-21130

GAS IONIZATION
Cluster beam studies
[AD-A176803] N87-21163

GAS LASERS
Laser microfabrication technology and its application to high speed interconnect of gate arrays
[DE87-004363] N87-21320

GAS MIXTURES
The study of combustion by means of diode laser spectroscopy N87-21201
Flow properties of He3 in dilute He3-He4 mixtures at temperatures between 10 and 150 mK
[ETN-87-99582] N87-21300
Derivation of working equations of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte with consideration of extracted oxygen N87-21575
Calculation of equilibrated concentrations of constituents of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte and corresponding values of theoretical voltage of dissociation N87-21576

GAS PRESSURE
Derivation of working equations of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte with consideration of extracted oxygen N87-21575

GAS TEMPERATURE
Sapphire fiber optic temperature probe N87-21186

GAS TUNGSTEN ARC WELDING
Ultrasonic detection of weld bead geometry
[DE87-000441] N87-21366

GAS TURBINE ENGINES
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor N87-21181
Turbine rotor blade measurements using infrared pyrometry N87-21188
High response data acquisition system N87-21189
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
Processing techniques for correlation of LDA and thermocouple signals N87-21194
Tip clearance measurement in modern compressor components N87-21199

GAS TURBINES
Materials for large land-based gas turbines
[PB87-120531] N87-20996
Velocity and temperature measurements in a can-type gas-turbine combustor N87-21184
The application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce N87-21198
Wake interaction effects on the transition process on turbine blades
[AD-A177094] N87-21272

GAS-GAS INTERACTIONS
Vorticity generation by shock propagation through bubbles in air
[AD-A176610] N87-21266

GAS-LIQUID INTERACTIONS
Computer code for gas-liquid two-phase vortex motions: GLVM
[NASA-CR-180265] N87-21139

GASES
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782

GATES (CIRCUITS)
Laser microfabrication technology and its application to high speed interconnect of gate arrays
[DE87-004363] N87-21320

GAUGE THEORY
The gauge field copies and Backlund transformation
[PREPRINT-513] N87-21632
Heavy Higgs production at future colliders
[PREPRINT-531] N87-21672
The d=2 conformal gauge theory
[NIKHEF-H/86-13] N87-21727
Gauge fixing for the field theory of the basonic string
[PREPRINT-527] N87-21729

GEARS
Analysis of vibration data from WHL (Westland Helicopters Limited) Wessex fatigue test trial 3
[AD-A176208] N87-21003

GENERAL AVIATION AIRCRAFT
Aircraft accident reports: Brief format, US civil and foreign aviation, issue number 14, 1986 accidents
[PB86-916926] N87-20980

GENETICS
European Science Notes, Volume 41, Number 2
[AD-A176116] N87-21843

GEODESY
Hardware design for a fixed-wing airborne gravity measurement system
[AD-A176620] N87-20993

GEODETIC SATELLITES
The representation of the Earth's gravitational potential in a spherical harmonic expansion to degree 250
[AD-A176479] N87-21431

GEOGRAPHIC INFORMATION SYSTEMS
REGIS: An RAE experimental image-based geographic information system
[RAE-TR-84103] N87-21405

GEOIDS
Ellipsoidal corrections to potential coefficients obtained from gravity anomaly data on the ellipsoid
[AD-A176901] N87-21435

GEOMAGNETISM
Solar-geophysical data number 507, November 1986. Part 1: (Prompt reports). Data for October, September 1986 and late data
[PB87-137766] N87-21448
Solar wind plasma in the magnetosphere method of entry and consequences
[AD-A177255] N87-21635

GEOMETRY
On the artificial viscosity in 1D spherical geometry
[DE87-004449] N87-21279

GEOPHYSICAL OBSERVATORIES
Haute-Provence (France) observatory lidar station, summary and outlook (1981-1986)
[ETN-87-99365] N87-21441

GEOPHYSICS
Geophysical Fluid Dynamics Laboratory activities FY86, plans FY87
[PB87-134458] N87-21403
Solar-geophysical data number 507, November 1986. Part 1: (Prompt reports). Data for October, September 1986 and late data
[PB87-137766] N87-21448
Solar-geophysical data number 507, November 1986. Part 2: (Comprehensive Reports). Data for May 1986 and miscellanea
[PB87-137774] N87-21449
Solar-geophysical data number 506, October 1986. Part 2: (Comprehensive reports). Data for April 1986
[PB87-126397] N87-21836

GEOSYNCHRONOUS ORBITS
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 1: Executive summary
[NASA-CR-179597-VOL-1] N87-21212
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 2: Technical report
[NASA-CR-179597-VOL-2] N87-21213

GERMANIUM
Superconducting properties of compositionally modulated Pb/Ge thin films
[DE87-004679] N87-21708

GET AWAY SPECIALS (STS)
Shuttle get-away special experiments N87-21157

GIACOBINI-ZINNER COMET
The comet Giacobini-Zinner magnetotail: Axial stresses and inferred near-nucleus properties
[DE87-003712] N87-21775
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784

GIANT STARS
Research in planetary studies and operation of the Mauna Kea Observatory
[NASA-CR-180513] N87-21763

GLASS
Failure strengths of laminated glass units
[PB87-116873] N87-21113
GLASS FIBER REINFORCED PLASTICS
Multi-axial failure criteria in fiber composites and their application to the through-thickness strength of hybrid fiber laminates N87-21040
The micromechanics of damage initiation and development under static and fatigue loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99985] N87-21044
Contribution to the study of the epoxy-glass interfaces in glass fiber reinforced composites
[ECL-86-10] N87-21055
GLASS FIBERS
Quasi-containerless glass formation method and apparatus
[NASA-CASE-MFS-28090-1] N87-21111
Fiber glass pulling — in space
[NASA-CR-179036] N87-21140
Modeling the convection-radiation coupling in porous materials and identification of their radiation characteristics: Application to glass wools
[INSA-86-ISAL-0007] N87-21290
GLIDERS
Proceedings of the Meteorological Motor Glider (MEMO) Workshop
[ESA-TT-945] N87-21453
Motor glider meteorology N87-21454
Typical and historical aspects of motor gliders as meteorological measuring aircraft N87-21455
A comparison between Falcon data and motor glider data N87-21458
Environmental-physical measurements and determination of atmospheric turbulence with the ASK-16 motor glider N87-21460
Motor glider measurements during the urban atmosphere energy budget experiment (EESA 1) N87-21464
Meteorological measurements with motor gliders in Poland N87-21466
GLOBAL ATMOSPHERIC RESEARCH PROGRAM
Proceedings of the International Conference on the Results of the Global Weather Experiment and Their Implications for the World Weather Watch, Volume 1
[WMO-TD-107-VOL-1] N87-21470
The objectives of the Global Weather Experiment and overall view of the accomplishment of GARP N87-21471
GARP's objectives in weather prediction. Expectations and realizations N87-21472
COSPAR's contribution to the early planning of the global observing system of the Global Weather Experiment N87-21473
The observational objectives and the implementation of the Global Weather Experiment N87-21474
Meteorological parameters derived from space-based observing systems, during the Global Weather Experiment and after N87-21475
Global diagnostic studies based on data collected during the Global Experiment — Global Weather Experiment N87-21483
Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1
[WMO-TD-VOL-1] N87-21485
The aim and conduct of ALPEX — Alpine Experiment (ALPEX) N87-21486
Review of the weather phenomena observed during the Alpine Experiment (ALPEX) special observing period N87-21487
Analysis and quality of Alpine Experiment (ALPEX) data N87-21488
The Mediterranean-Alpine Experiment (MED-ALPEX) data set N87-21489
The quality of the Alpine Experiment (ALPEX) 2b data set with regard to the application of vorticity dynamics N87-21490
A variational objective analysis scheme for analysis of the ALPEX data set — Alpine Experiment (ALPEX) N87-21491
Results of the Alpine Experiment (ALPEX) aircraft intercomparison on 19 April 1982 N87-21493
Meteosat contribution to Alpine Experiment (ALPEX): Highlights and limits N87-21495
Multivariate analyses of ALPEX satellite retrievals — Alpine Experiment (ALPEX) N87-21496
Remotely sensed sea surface temperature for the Alpine Experiment (ALPEX) — AVHRR-2 data N87-21497
On the synoptics and dynamics of orographically induced cyclones in the Mediterranean N87-21506
GLOBAL POSITIONING SYSTEM
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms
[AD-A176218] N87-20983
Accuracy of time transfer in satellite systems
[AD-A176579] N87-20984
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985
GLYCOLYSIS
Hydrolysis, transport and utilization of carbohydrates in rats with restricted motor activity N87-21567
GOATS
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness
[AD-A176558] N87-21556
GOVERNMENT PROCUREMENT
Improving the transfer and use of scientific and technical information: The Federal role. Volume 1: Summary and conclusions
[PB87-142915] N87-21746
GOVERNMENT/INDUSTRY RELATIONS
Improving the transfer and use of scientific and technical information: The Federal role. Volume 1: Summary and conclusions
[PB87-142915] N87-21746
Improving the transfer and use of scientific and technical information: The federal role. Volume 2: Problems and issues in the transfer and use of STI
[PB87-142923] N87-21747
GRADIENTS
Retrievals of lower stratospheric ozone profiles from Nimbus-4 and their use in a synoptic-climatological study N87-21423
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
GRAIN BOUNDARIES
Effect of grain boundary structure on sensitization and corrosion of stainless steel
[AD-A176299] N87-21081
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE87-006152] N87-21103
Grain boundary composition effects on environmentally induced cracking of engineering materials
[DE87-006405] N87-21105
EXAFS studies of grain boundary diffusion and segregation
[DE87-003435] N87-21702
Computer simulation of special grain boundaries in metals and ionic materials
[DE87-004989] N87-21707
Grain-boundary modeling
[DE87-004737] N87-21710
Computer generation of convergent beam electron diffraction patterns — crystallography
[ETN-87-99578] N87-21719
GRAIN SIZE
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
Creep cavitation in a nickel aluminide
[DE87-004392] N87-21106
GRAPHIC ARTS
FY86 independent research/independent exploratory development
[AD-A176944] N87-21589
The X window system
[AD-A176476] N87-21604
GRAPHITE
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: An initial study
[NASA-TM-89646] N87-21043
Localized plasticity of graphite/magnesium metal matrix composites
[DE87-004542] N87-21053
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Analysis of picosecond pulsed laser melted graphite
[DE87-003755] N87-21124
Graphite as a picosecond laser activated opening switch
[DE87-003758] N87-21251
Research on cryogenic vacuum tunneling
[AD-A176390] N87-21662
GRAPHITE-EPOXY COMPOSITES
Multi-axial failure criteria in fiber composites and their application to the through-thickness strength of hybrid fiber laminates N87-21040
Resistance curve approach to predicting residual strength of composites
[AD-A176984] N87-21050
GRAPHITIZATION
Composite service life prediction via fiber bundle testing. Evaluation of testing equipment and data acquisition system
[AD-A176835] N87-21365
GRAPHS (CHARTS)
White light solar corona: An atlas of 1985 K-coronameter synoptic charts, December 1984 - December 1985
[PB87-138095] N87-21837
GRATINGS (SPECTRA)
Scattering from general periodic screens
[AD-A176405] N87-21216
GRAVIMETRY
Hardware design for a fixed-wing airborne gravity measurement system
[AD-A176820] N87-20993
Gravimetric technique for the preparation of accurate trace organic gas standards
[PB87-145736] N87-21074
GRAVITATION
Hardware design for a fixed-wing airborne gravity measurement system
[AD-A176820] N87-20993
The gravitational properties of antimatter
[DE87-003367] N87-21725
GRAVITATION THEORY
The d=2 conformal gauge theory
[NIKHEF-H/86-13] N87-21727
GRAVITATIONAL EFFECTS
The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary
[NASA-CR-178276] N87-21020
Mechanism of action of local negative pressure applied to human body on dynamics of central circulation N87-21579
GRAVITATIONAL FIELDS
Field assisted etching
[RSRE-MEMO-3715] N87-21161
The representation of the Earth's gravitational potential in a spherical harmonic expansion to degree 250
[AD-A176479] N87-21431
Gravitation waves. Proceedings of the conference on design of gravitational wave radiator and detector
[DE87-780075] N87-21439
GRAVITATIONAL PHYSIOLOGY
Morphological and biochemical analysis of some rat organs and tissues following exposure to 1.1 and 2.0 G gravity N87-21569
GRAVITATIONAL WAVE ANTENNAS
Study of the free oscillations of the Earth based on gravitional antenna data
[NOTA-INTERNA-668] N87-21447
GRAVITY ANOMALIES
The representation of the Earth's gravitational potential in a spherical harmonic expansion to degree 250
[AD-A176479] N87-21431
Ellipsoidal corrections to potential coefficients obtained from gravity anomaly data on the ellipsoid
[AD-A176901] N87-21435
GRAVITY WAVES
Gravitation waves. Proceedings of the conference on design of gravitational wave radiator and detector
[DE87-780075] N87-21439
GROUND SUPPORT SYSTEMS
Ground de-icing of aircraft
[CAP-512] N87-20975
GROUND WAVE PROPAGATION
Ground-wave analysis model for MF broadcast systems
[PB87-124293] N87-21228
GROUP DYNAMICS
Group dynamics and performance efficiency under extreme conditions N87-21578
GUIDANCE (MOTION)
Activities report of the Department of Reconnaissance and Seeker Systems
[FOA-C-30433-3.1/3.2/3.3/3.4] N87-21227
GULF STREAM
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
The Gulf Stream dynamics experiment: Inverted echo sounder data report for the July 1982 to April 1983 deployment period
[AD-A176776] N87-21543

H

H ALPHA LINE
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810
Rapid changes in H alpha-flares correlated with microwaves N87-21817
HABITABILITY
Space station group activities habitability module study
[NASA-CR-4010] N87-21585

HADRONS
Joint production of phi mesons and pi(+,-), pi(0), rho, rho bar, K(0)S and K(+,-) in hadronic interactions
[NIKHEF-H/86-2] N87-21663
Hadron phenomenology via the fire-string model
[PREPRINT-533] N87-21731

HALL EFFECT
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Superlattice effects in graphite intercalation compounds
[AD-A176879] N87-21694

HALLEY'S COMET
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
Model ion abundances for comet Halley
[DE87-003710] N87-21783

HAMILTONIAN FUNCTIONS
The octet nonleptonic Hamiltonian and current algebra on the lattice with Wilson fermions
[PREPRINT-525] N87-21636
The relevance of connectance on the Lyapunov characteristic exponents of products of symplectic random matrices
[PREPRINT-519] N87-21643
Symmetries and bi-Hamiltonian structures of 2+1 dimensional systems
[PREPRINT-536] N87-21644
Integrable 2+1 dimensional equations, their recursion operators and bi-Hamiltonian structures as reduction of multidimensional systems
[PREPRINT-540] N87-21645
Versatile three-dimensional Hamiltonian ray-tracing program for acoustic waves in the atmosphere above irregular terrain
[PB87-115804] N87-21659

HANDBOOKS
Operations handbook-ozone measurements to 40-km altitude with Model 4A Electrochemical Concentration Cell (ECC) ozonesonase (used with 1680-MHz radiosondes)
[PB87-113874] N87-21426
Handbook for operation and maintenance of an NBS (National Bureau of Standards) multisensor automated EM (electromagnetic) field measurement system
[PB87-140729] N87-21749

HANDLING EQUIPMENT
A flexible, computer-integrated robotic transfer system
[DE87-004183] N87-21619

HANKEL FUNCTIONS
Some computational results on size reduction in H sup inf design
[OUEL-1648/86] N87-21627

HARDENING (MATERIALS)
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384

HARDNESS
Fracture and hardness of semiconductor alloys
[AD-A176800] N87-21088
On the correlation of hardness with tensile and yield strength
[VTT-416] N87-21109

HARDWARE
Tabulated output from ELLA — hardware design and description language (ELLA)
[RSRE-MEMO-3966] N87-21602

HARMONIC GENERATIONS
Period three generation on microwave-induced constant-voltage steps of Josephson tunnel junctions
[DE87-003530] N87-21700

HAZE DETECTION
Haze climate of the United States
[PB87-141057] N87-21529

HEAD (ANATOMY)
Preliminary development, head-neck simulator. Volume 1: Analysis volunteer tests
[PB87-133245] N87-21553
Preliminary development head-neck simulator. Volume 2: Mathematical simulations
[PB87-142196] N87-21557

HEAD DOWN TILT
Individual distinctions of fluid-electrolyte metabolism during hypokinesia with head-down tilt for 120 days and efficacy of preventive agents N87-21562
Change in bile acid and lipid content of human bile during exposure to antiorthostatic hypokinesia and its correction N87-21565
Quantitative study of osteoblasts and osteoclasts of rat bones with simulation of weightlessness N87-21566
Effect of altered circulation on human nystagmic reactions N87-21570

HEAD MOVEMENT
Preliminary development head-neck simulator. Volume 2: Mathematical simulations
[PB87-142196] N87-21557

HEARING
Thresholds of long-latency-period potentials and sensation of motion evoked in man by linear accelerations N87-21571

HEART FUNCTION
Neurohumoral and mechanical factors in the modulation of left ventricular mass
[NASA-CR-180524] N87-21554

HEART RATE
Bioelectrical activity of the heart and blood electrolytes in essentially healthy subjects submitted to antiorthostatic hypokinesia for 120 days N87-21563

HEAT EXCHANGERS
A correlation for the heat transfer coefficient in a rectangular passage containing protuberance
[AD-A176111] N87-21261

HEAT FLUX
Case studies for flux measurements along a low-flying route to the south of Munich N87-21459

HEAT RESISTANT ALLOYS
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Superalloy resources: Supply and availability
[NASA-TM-88866] N87-21077
High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms
[AD-A176211] N87-21079

HEAT SOURCES
Experimental determination of the stable-trim attitudes of two proposed, general-purpose, heat-source modules
[NASA-TM-88345] N87-20967

HEAT TRANSFER
Performance analysis of advanced spacecraft TPS
[NASA-CR-180496] N87-21011
Wake interaction effects on the transition process on turbine blades
[AD-A177094] N87-21272
Convectively driven superfluid turbulence in dilute solutions of He3 in superfluid He4
[DE87-002918] N87-21275
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions
[NASA-CR-180272] N87-21303
Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems
[PREPRINT-542] N87-21674

HEAT TRANSFER COEFFICIENTS
Digital image processing applied to fluid dynamic problems N87-21193
A correlation for the heat transfer coefficient in a rectangular passage containing protuberance
[AD-A176111] N87-21261

HEAVY WATER
Raman spectra of water in the translational and librational regions. Part 1: Study of the depolarization ratio
[PREPRINT-534] N87-21071

HEIGHT
The variation of pressure on the ground with height of burst of high explosive charges
[AWRE-O-9/86] N87-21258

HELICOPTER PERFORMANCE
Hover performance of a remotely piloted helicopter
[AD-A176587] N87-20992

HELICOPTERS
Analysis of vibration data from WHL (Westland Helicopters Limited) Wessex fatigue test trial 3
[AD-A176208] N87-21003
Human factors research in aircrew performance and training
[AD-A176099] N87-21586

HELIUM
Convectively driven superfluid turbulence in dilute solutions of He3 in superfluid He4
[DE87-002918] N87-21275
Pulsations of white dwarf stars with thick hydrogen or helium surface layers
[DE87-001954] N87-21774

HELIUM ISOTOPES
Flow properties of He3 in dilute He3-He4 mixtures at temperatures between 10 and 150 mK
[ETN-87-99582] N87-21300

HELIUM-NEON LASERS
The absolute measuring accuracy of technical laser interferometers
[ETN-87-99560] N87-21331

HEMATOPOIESIS
Effect of spaceflight factors on hemopoiesis N87-21560

HEMODYNAMIC RESPONSES
Effect of spaceflight factors on hemopoiesis N87-21560
Effect of altered circulation on human nystagmic reactions N87-21570
Some pathological signs in pelvis minor organs after exposure to long-term high-level +Gz accelerations N87-21577

HERMETIC SEALS
Method for forming hermetic seals
[NASA-CASE-NPO-16423-1-CU] N87-21334

HIERARCHIES
The X window system
[AD-A176476] N87-21604
Hierarchies of integrable equations obtained as nonisopectral (in X and T) deformations of the Schroedinger spectral problem
[PREPRINT-522] N87-21633

HIGH ALTITUDE
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft
[AD-A176815] N87-21024

HIGH ENERGY INTERACTIONS
A drift chamber with variable drift velocity
[NIKHEF-H/86-12] N87-21310
Determination of the linear aperture of the SSC (Superconducting Supercollider) clustered lattice used for the conceptual design report
[DE87-004179] N87-21686

HIGH POWER LASERS
A self-similar approach to the explosion of droplets by a high energy laser beam
[DE87-005124] N87-21322

HIGH PRESSURE
CARS thermometry for low and high pressure combustion systems N87-21172

HIGH RESOLUTION
A quick look at the first NRL short pulse 95 GHz radar flight data
[AD-A176182] N87-21214

HIGH SPEED
Summary of studies to reduce wing-mounted propfan installation drag on an M = 0.8 transport
[NASA-TP-2678] N87-20990
A quick look at the first NRL short pulse 95 GHz radar flight data
[AD-A176182] N87-21214
Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year-1
[AD-A176639] N87-21681

HIGH STRENGTH STEELS
Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels
[DE87-004000] N87-21092
Submerged arc welding of high strength structural steels
[VTT-436] N87-21361

HIGH TEMPERATURE
Development of alumina- and mullite-SiC whisker composites: High temperature properties
[DE87-004624] N87-21052
Proceedings of the International Workshop on High-Temperature Molten Salt Batteries
[DE87-003297] N87-21248
Metal hydride temperature amplifiers for high temperature (260 C) applications: A parametric study
[DE87-005297] N87-21415
High-temperature relative enthalpies of V2O5: Report of investigations/1986
[PB87-140737] N87-21733

HIGH TEMPERATURE AIR
High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms
[AD-A176211] N87-21079

HIGH TEMPERATURE PLASMAS
Experimental and theoretical studies of laser propulsion phenomenology
[AD-A176851] N87-21315
Pick-up ion trajectories in a comet model
[AD-A176618] N87-21770

HILBERT SPACE
Supermultiplets in Hilbert space for the supersymmetric bag model
[NIKHEF-H/86-5] N87-21664

HIPPARCOS SATELLITE
Ad astra HIPPARCOS. Astronomical mission of the European Space Agency
[ESA-BR-24] N87-21766

HISTORIES
Gravitation waves. Proceedings of the conference on design of gravitational wave radiator and detector
[DE87-760075] N87-21439
GARP's objectives in weather prediction. Expectations and realizations N87-21472

HOLOGRAPHIC INTERFEROMETRY
The application of holography as a transonic flow diagnostic to rotating components in turbomachinery N87-21202
A study of passage flow through a cascade of turbine blades using image plane holographic interferometry N87-21203
Beam-modulation methods in quantitative and flow-visualization holographic interferometry N87-21204
HOLOGRAPHY
Holographic investigation of metallized solid propellant combustion in a three-dimensional motor [AD-A176140] N87-21131
Implementation of three speckle reduction filters for solid propellant combustion holograms [AD-A176583] N87-21132
Study of various holographic assemblies to observe particles smaller than diffraction length, in flows with or without density gradients [IMFL-86/21] N87-21309
Activities report in physics [ETN-87-99368] N87-21844
HOMOGENEITY
Saturation effects in coupled lasers with homogeneous gain [AD-A176843] N87-21314
HOOP COLUMN ANTENNAS
Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] N87-21021
HORIZONTAL ORIENTATION
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder [AD-A176578] N87-21432
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar [AD-A176662] N87-21433
HOT ISOSTATIC PRESSING
Densification of titanium powder during hot isostatic pressing [AD-A176617] N87-21084
Microstructural response of rapidly solidified 304 stainless steel powder to three consolidation techniques [DE87-000439] N87-21100
HOT PRESSING
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California [AD-A176510] N87-20959
HOT SURFACES
High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms [AD-A176211] N87-21079
HOT-WIRE FLOWMETERS
La Recherche Aerospatiale, bimonthly bulletin, number 1986-2, 231/March-April [ESA-TT-986] N87-20974
HOVERING
Hover performance of a remotely piloted helicopter [AD-A176587] N87-20992
HUMAN BEHAVIOR
Theoretical development for identifying underlying internal processes. Volume 1. The theory of underlying internal processes [AD-A176466] N87-21588
HUMAN FACTORS ENGINEERING
Preliminary development head-neck simulator. Volume 2: Mathematical simulations [PB87-142196] N87-21557
Space station group activities habitability module study [NASA-CR-4010] N87-21585
Human factors research in aircrew performance and training [AD-A176099] N87-21586
Theoretical development for identifying underlying internal processes. Volume 1. The theory of underlying internal processes [AD-A176466] N87-21588
FY86 independent research/independent exploratory development [AD-A176944] N87-21589
HUMAN PERFORMANCE
Sleep deprivation and exercise tolerance [AD-A176171] N87-21555
Group dynamics and performance efficiency under extreme conditions N87-21578
Theoretical development for identifying underlying internal processes. Volume 1. The theory of underlying internal processes [AD-A176466] N87-21588
FY86 independent research/independent exploratory development [AD-A176944] N87-21589
HUMAN TOLERANCES
USSR Report: Space Biology and Aerospace Medicine, Volume 20, No. 6, November - December 1986 [JPRS-USB-87-001] N87-21558
HYDRAULIC EQUIPMENT
Modeling and experimental validation of a single-link flexible manipulator [AD-A176614] N87-21338
Personnel emergency carrier vehicle [NASA-CASE-KSC-11282-1] N87-21755
HYDRAULIC FLUIDS
Determination of chloride in hydraulic fluids [AD-A176406] N87-21060
HYDRAZINE ENGINES
A simplified appraisal of the pulsed performance of electrothermal hydrazine thrusters [RAE-TM-SPACE-355] N87-21033
HYDRIDES
Ten degree Kelvin hydride refrigerator [NASA-CASE-NPO-16393-1-CU] N87-21159
HYDROCARBONS
Prediction of fire properties of materials. Part 1: Aliphatic and aromatic hydrocarbons and related polymers [PB87-140240] N87-21072
Infrared absorption and emission characteristics of interstellar PAHs [NASA-TM-89287] N87-21075
The hydrogen coverage of interstellar PAHs [NASA-TM-89340] N87-21780
HYDROCHLORIC ACID
Advanced B and Al combustion kinetics studies over wide temperature ranges [AD-A176826] N87-21061
HYDRODYNAMICS
Development of a two-equation turbulent mix model [DE87-005837] N87-21284
A self-similar approach to the explosion of droplets by a high energy laser beam [DE87-005124] N87-21322
Relativistic (3+1) dimensional hydrodynamic simulations of compact interacting binary systems [DE87-000602] N87-21771
HYDROGEN
Pulsations of white dwarf stars with thick hydrogen or helium surface layers [DE87-001954] N87-21774
HYDROGEN EMBRITTLEMENT
Grain boundary composition effects on environmentally induced cracking of engineering materials [DE87-006405] N87-21105
HYDROGEN 4
Tetrahydrogen [AD-A176778] N87-21133
HYDROGRAPHY
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms [AD-A176218] N87-20983
Characteristics of the two-dimensional spectrum of roughness on a seamount [AD-A176366] N87-21538
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA21, 7-20 July 1986 [AD-A176638] N87-21541
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986 [AD-A176639] N87-21542
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986 [AD-A176795] N87-21544
HYDROLYSIS
Hydrolysis, transport and utilization of carbohydrates in rats with restricted motor activity N87-21567
HYDROPHONES
The improvement and evaluation of a laser interferometer for the absolute measurement of ultrasonic displacements in the frequency range up to 15 MHz — hydrophones [NPL-AC-109] N87-21311
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source [AD-A176344] N87-21536
HYGRAL PROPERTIES
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination [ETN-87-99577] N87-21057
HYPERBOLIC DIFFERENTIAL EQUATIONS
Cubic Interpolated pseudo-Particle (CIP): A new numerical solver for general nonlinear hyperbolic equations in multidimension [KFK-4154] N87-21631
HYPERSONIC FLOW
Study of non-equilibrium transport phenomena [NASA-CR-180441] N87-20985
A spatial marching technique for the inviscid blunt body problem [DE87-004526] N87-20972
HYPERTENSION
Neurohumoral and mechanical factors in the modulation of left ventricular mass [NASA-CR-180524] N87-21554
HYPERVELOCITY LAUNCHERS
Experimental results from railgun firings involving magnetic flux probes [MRL-TN-509] N87-21008
HYPODYNAMIA
Possibility of pharmacological correction of regional osteoporosis in nonbearing extremity N87-21568
HYPOGLYCEMIA
Hydrolysis, transport and utilization of carbohydrates in rats with restricted motor activity N87-21567
HYPOKINESIA
USSR Report: Space Biology and Aerospace Medicine, Volume 20, No. 6, November - December 1986 [JPRS-USB-87-001] N87-21558
Individual distinctions of fluid-electrolyte metabolism during hypokinesia with head-down tilt for 120 days and efficacy of preventive agents N87-21562
Bioelectrical activity of the heart and blood electrolytes in essentially healthy subjects submitted to antiorthostatic hypokinesia for 120 days N87-21563
Effect of immersion hypokinesia on some parameters of human muscle potentials N87-21564
Change in bile acid and lipid content of human bile during exposure to antiorthostatic hypokinesia and its correction N87-21565
Quantitative study of osteoblasts and osteoclasts of rat bones with simulation of weightlessness N87-21566
Hydrolysis, transport and utilization of carbohydrates in rats with restricted motor activity N87-21567
Rat brain polyamine levels during long-term hypokinesia N87-21580
Reaction of sympathectomied rat opioid system to immobilization stress N87-21581
HYSTERESIS
Modeling and control of the Stanford/JPL hand [DE87-005847] N87-21353
Superlattice effects in graphite intercalation compounds [AD-A176879] N87-21694

I

ICE
The P/Giacobini-Zinner magnetotail [DE87-003761] N87-21784
ICE PREVENTION
Ice-melting characteristics of calcium magnesium acetate [PB87-122123] N87-21167
IDENTIFYING
Identification of material constants for a composite shell structure [DE87-004524] N87-21395
IMAGE PROCESSING
Implementation of three speckle reduction filters for solid propellant combustion holograms [AD-A176583] N87-21132
Digital image processing applied to fluid dynamic problems N87-21193
Automatic processing system for shadowgraph and interference patterns [NASA-TM-88525] N87-21307
An experimental and analytical program to develop crack tip fracture criteria [AD-A176853] N87-21382
Morphological transformations of binary images [FOA-30447-3.3] N87-21609
IMAGES
Rapid search for spherical objects in aerial photographs [AD-A176391] N87-21406
IMAGING TECHNIQUES
Development of nuclear magnetic resonance imaging techniques for characterizing green-state ceramic materials [DE87-004987] N87-21123
Study of various holographic assemblies to observe particles smaller than diffraction length, in flows with or without density gradients [IMFL-86/21] N87-21309
Optical scanner [NASA-CASE-GSC-12897-1] N87-21679

IMIDES
Process for preparing phthalocyanine polymer from imide containing biphthalonitrile
[NASA-CASE-ARC-11511-2] N87-21112
IMMOBILIZATION
Reaction of sympathectomied rat opioid system to immobilization stress N87-21581
IMPACT
On impact dynamics of robotic operations
[AD-A176464] N87-21337
IMPACT DAMAGE
The effects of impact damage in tapered-thickness CFRP laminates
[RAE-TR-85067] N87-21045
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048
IMPACT RESISTANCE
Impact verification of space suit design for space station
[NASA-CR-180456] N87-21584
IMPACT TESTS
Preliminary development, head-neck simulator. Volume 1: Analysis volunteer tests
[PB87-133245] N87-21553
IMPEDANCE
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
A numerical method for solving for normal modes with impedance bottom
[AD-A176591] N87-21540
IMPEDANCE MEASUREMENT
Test methodology for adaptive antenna systems
[AD-A176295] N87-21215
IMPELLERS
Vibration analysis by speckle interferometry N87-21197
IMPROVEMENT
Improvement of fatigue life prediction accuracy for various realistic loading spectra by use of correction factors
[TAE-581] N87-21374
IMPURITIES
High efficiency crystalline silicon solar cells
[NASA-CR-180530] N87-21411
IN-FLIGHT MONITORING
In-flight surface oil-flow photographs with comparisons to pressure distribution and boundary-layer data
[NASA-TP-2395] N87-20966
INCOHERENT SCATTER RADAR
A theoretical study of calibration procedures for coherent and non-coherent polarimetric radars
[RSRE-88011] N87-21210
INCOMPRESSIBLE FLOW
Computer-aided analysis of two-dimensional laminar and turbulent incompressible flows N87-21256
Maximum principle for viscous fluids flowing through regions of pure fluid and mixtures
[DE86-760543] N87-21277
An investigation of the closure conditions for two-fluid models of two-phase flow
[DE87-004792] N87-21287
Solution of the steady state incompressible Navier-Stokes equations in curvilinear nonorthogonal coordinates
[VKI-TN-158] N87-21297
The influence of the wall boundary condition on a solution of the incompressible Navier-Stokes equation
[VKI-TM-42] N87-21298
INCONEL (TRADEMARK)
Effect of manufacturing processes on structural allowables
[AD-A176232] N87-21080
INDEPENDENT VARIABLES
Data approximation by splines in one and two independent variables
[NPL-DITC-77/86] N87-21623
INDEXES (DOCUMENTATION)
Abstracts of papers submitted in 1985 for publication (for Woods Hole Oceanographic Institution)
[PB87-129433] N87-21532
University program management information system, fiscal year 1986.
[PB87-127379] N87-21736
INDIAN OCEAN
Tidal estimation in the Atlantic and Indian Oceans, 3 deg x 3 deg solution
[NASA-TM-87812] N87-21534
Is the Somali Current a biological river in the Northwestern Indian Ocean
[DE87-003233] N87-21548
INDIUM PHOSPHIDES
Investigations on the MBE growth and properties of Al/(y)/Ga/(y)/In/(1-x-y/As/InP) and InAlAs superlattices
[DE87-005190] N87-21709
INDUCTANCE
The magnetic flux contributed by the plasma armature in an electromagnetic launcher
[MRL-R-1033] N87-21009
INELASTIC SCATTERING
Thermomechanical effects in inelastic materials and structures
[AD-A177076] N87-21386
Model results with PIE (Polar Ionospheric Irregularities Experiment) rocket data
[AD-A176999] N87-21436
INFORMATION DISSEMINATION
MARC (Machine Readable Catalog) format and life cycle tracking at the National Archives: A study
[PB87-126256] N87-21737
INFORMATION FLOW
MARC (Machine Readable Catalog) format and life cycle tracking at the National Archives: A study
[PB87-126256] N87-21737
INFORMATION MANAGEMENT
Management of automation projects that are relevant for the Royal Dutch Meteorological Institute (KNMI)
[NLR-MP-85075-U] N87-21734
Using bar code technology to enhance classified document accountability
[DE87-000760] N87-21739
INFORMATION RETRIEVAL
MARC (Machine Readable Catalog) format and life cycle tracking at the National Archives: A study
[PB87-126256] N87-21737
INFORMATION SYSTEMS
Atmospheric climate data: Problems and promises
[NASA-CR-180442] N87-21450
Information systems inventory user instruction manual
[PB87-131009] N87-21612
Management of automation projects that are relevant for the Royal Dutch Meteorological Institute (KNMI)
[NLR-MP-85075-U] N87-21734
MARC (Machine Readable Catalog) format and life cycle tracking at the National Archives: A study
[PB87-126256] N87-21737
Applied informatics in practice
[NLR-MP-85028-U] N87-21742
Automation strategy for a Royal Netherlands Air Force (RNLAF) air base command and control information system
[NLR-MP-85070] N87-21743
Activities report of the Information Systems Department
[FOA-C-30441-3.3] N87-21745
Advanced sensors, telecommunications and data processing: Technological spin-offs from the Strategic Defense Initiative
[DE87-003884] N87-21757
INFORMATION THEORY
Applied informatics in practice
[NLR-MP-85028-U] N87-21742
INFORMATION TRANSFER
MARC (Machine Readable Catalog) format and life cycle tracking at the National Archives: A study
[PB87-126256] N87-21737
INFRARED DETECTORS
Sapphire fiber optic temperature probe N87-21186
INFRARED IMAGERY
Digital image processing applied to fluid dynamic problems N87-21193
INFRARED INSTRUMENTS
Turbine rotor blade measurements using infrared pyrometry N87-21188
INFRARED RADIATION
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432
INFRASONIC FREQUENCIES
Antarctic atmospheric infrasound
[AD-A176804] N87-21434
INGESTION (BIOLOGY)
EWAM: A model for predicting food and water ingestion, and inhalation rates of man
[DE86-900117] N87-21590
INHIBITORS
Inhibition of localized corrosion
[AD-A176573] N87-21083
INLET FLOW
A new design concept for indraft wind-tunnel inlets with application to the national full-scale aerodynamic complex
[NASA-TM-88226] N87-21006
INOCULATION
Seeding gas flows for laser anemometry N87-21178
Analysis of the feasibility of silicon on insulator submicron CMOS technology
[ECL-86-07] N87-21716
INSPECTION
The application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce N87-21198
Inspection of complex profiles: A review of the methods available, and best suited to the needs of RAE Pyestock
[RAE-TM-P-1077] N87-21306
INTAKE SYSTEMS
Flow induction by rotary jets
[AD-A177013] N87-21270
INTEGRATED CIRCUITS
Ion beam sputter etching
[NASA-CASE-LEW-13690-1] N87-21160
Biological materials for integrated circuits
[RSRE-MEMO-3965] N87-21237
Rapid isothermal processing systems: An overview
[RSRE-MEMO-3967] N87-21238
Laser microfabrication technology and its application to high speed interconnect of gate arrays
[DE87-004383] N87-21320
GaAs photoconductors to characterize picosecond response in GaAs integrated devices and circuits
[DE87-003744] N87-21704
INTELLIGIBILITY
Comparison of the effects of broad-band noise on speech intelligibility and voice quality ratings
[AD-A176900] N87-21221
INTERATOMIC FORCES
Computer simulation of special grain boundaries in metals and ionic materials
[DE87-004989] N87-21707
INTERCALATION
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Superlattice effects in graphite intercalation compounds
[AD-A176879] N87-21694
INTERFACES
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023
Contribution to the study of the epoxy-glass interfaces in glass fiber reinforced composites
[ECL-86-10] N87-21055
Development of a two-equation turbulent mix model
[DE87-005837] N87-21284
Mobile robots in research and development programs at the Savannah River site
[DE87-003114] N87-21352
The X window system
[AD-A176478] N87-21604
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces
[AD-A176445] N87-21691
EXAFS studies of grain boundary diffusion and segregation
[DE87-003435] N87-21702
INTERFACIAL TENSION
Fluctuations in membranes with crystalline and hexatic order
[PREPRINT-538] N87-21402
INTERFEROMETERS
Low noise lead screw positioner
[NASA-CASE-NPO-15617-1] N87-21304
INTERFEROMETRY
Vibration analysis by speckle interferometry N87-21197
The low frequency space array
[AD-A177115] N87-21758
INTERGRANULAR CORROSION
Grain boundary composition effects on environmentally induced cracking of engineering materials
[DE87-006405] N87-21105
Creep cavitation in a nickel aluminide
[DE87-004392] N87-21106
INTERMETALLICS
Inertia friction welding of 1100 aluminum to type 316 stainless steel
[DE87-005044] N87-21347
Metal hydride temperature amplifiers for high temperature (260 C) applications: A parametric study
[DE87-005297] N87-21415
Electromechanical properties of superconductors for high-energy physics applications
[DE87-006048] N87-21715
INTERMITTENCY
Intermittency as multifractality in history space
[PREPRINT-518] N87-21639
INTERNAL COMBUSTION ENGINES
Introduction and status of the ceramic technology for advanced heat engines project
[DE87-004403] N87-21122

Three dimensional numerical simulations of the UPS-292-SC engine
[DE87-001966] N87-21344

INTERNAL WAVES
Vortex motion in a stratified medium
[AD-A176729] N87-21269
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539

INTERNATIONAL COOPERATION
Proceedings of the International Conference on the Results of the Global Weather Experiment and Their Implications for the World Weather Watch, Volume 1
[WMO-TD-107-VOL-1] N87-21470
The objectives of the Global Weather Experiment and overall view of the accomplishment of GARP N87-21471

INTERNATIONAL LAW
Space stations and the law: Selected legal issues
[PB87-118220] N87-21754

INTERPLANETARY MAGNETIC FIELDS
Pick-up ion trajectories in a comet model
[AD-A176618] N87-21770

INTERPOLATION
Four-dimensional data assimilation — numerical weather forecasting N87-21481
Assessment of results from different analysis schemes — GARP N87-21482
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
A method for the construction of continuously differentiable surfaces for the interpolation of scattered data
[HMI-B371] N87-21628
Cubic Interpolated pseudo-Particle (CIP): A new numerical solver for general nonlinear hyperbolic equations in multidimension
[KFK-4154] N87-21631

INTERSTELLAR MASERS
Electron-cyclotron maser and solar microwave millisecond spike emission N87-21619

INTERSTELLAR SPACE
Infrared absorption and emission characteristics of interstellar PAHs
[NASA-TM-89287] N87-21075

INVENTORIES
Information systems inventory user instruction manual
[PB87-131009] N87-21612

INVISCID FLOW
An approach to practical aerodynamic calculations
[AD-A176995] N87-20970
A spatial marching technique for the inviscid blunt body problem
[DE87-004526] N87-20972
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341

IODINE ISOTOPES
Laser microprobe studies of rare gas isotopes in meteorites N87-21769

ION BEAMS
Ion beam sputter etching
[NASA-CASE-LEW-13899-1] N87-21160
Generation of intense negative ion beams
[NASA-CASE-NPO-16061-1-CU] N87-21660
Stress release in ion implanted lattice mismatched semiconductor heterostructures
[DE87-004518] N87-21703
The effect of ion damage and annealing on superconducting transition metal-nitride compounds
[DE87-005998] N87-21712
Kinetics and thermodynamics of quasicrystals as determined by surface modification techniques
[DE87-005538] N87-21713

ION ENGINES
The NASA Electric Propulsion Program
[NASA-TM-89856] N87-21037
Precision tunable resonant microwave cavity
[NASA-CASE-LEW-13935-1] N87-21234

ION IMPLANTATION
Stress release in ion implanted lattice mismatched semiconductor heterostructures
[DE87-004518] N87-21703

ION SCATTERING
Pick-up ion trajectories in a comet model
[AD-A176618] N87-21770

ION SELECTIVE ELECTRODES
Determination of chloride in hydraulic fluids
[AD-A176406] N87-21060

IONIC CRYSTALS
Computer simulation of special grain boundaries in metals and ionic materials
[DE87-004989] N87-21707

IONIZATION CHAMBERS
A drift chamber with variable drift velocity
[NIKHEF-H/86-12] N87-21310

IONOSPHERIC DISTURBANCES
Model results with PIIE (Polar Ionospheric Irregularities Experiment) rocket data
[AD-A176999] N87-21436
The interchange instability in high-latitude plasma blobs
[AD-A176242] N87-21685

IONOSPHERIC PROPAGATION
The low frequency space array
[AD-A177115] N87-21758

IONS
Pick-up ion trajectories in a comet model
[AD-A176618] N87-21770
Model ion abundances for comet Halley
[DE87-003710] N87-21783

IRON
Ductile iron data base. Correlations between microstructure and fracture toughness: Background document for draft ASTM ductile iron specification
[DE87-006010] N87-21107

IRON ALLOYS
Fracture properties of ferritic, ferritic-pearlitic, pearlitic and bainitic nodular cast irons
[VTT-430] N87-21110

IRRADIANCE
Comparison of long-wave and shortwave irradiances at satellite altitude with integrated scanner measurements using the Nimbus 7 ERB data set
[NASA-CR-177909] N87-21834

IRRADIATION
Effects of irradiation on the fracture toughness of Alloy 718 plate and weld
[DE87-004345] N87-21102
Radiosensitivity of escherichia coli following irradiation in a stationary magnetic field N87-21582

IRREGULARITIES
Irregular modes in a duct with an impedance wall
[NLR-MP-85066-U] N87-21656

ISENTROPIC PROCESSES
Numerical simulation of lee cyclogenesis during Alpine Experiment with an isentropic coordinate model N87-21504
Quasi-Lagrangian diagnostics of a Mediterranean cyclone: Isentropic results N87-21507
Fine mesh analysis of Genoa cyclogenesis by use of isentropic coordinates N87-21509

ISLAND ARCS
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519

ISOSTATIC PRESSURE
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959

ISOTHERMAL FLOW
High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms
[AD-A176211] N87-21079

ISOTHERMAL PROCESSES
Rapid isothermal processing systems: An overview
[RSRE-MEMO-3967] N87-21236

ISOTROPIC TURBULENCE
Numerical simulation of turbulent reactive flows
[ETN-87-99398] N87-21289

ITALY
School and the nuclear energy problems: Preliminary analysis of a questionnaire
[NOTA-INTERNA-873] N87-21678

J

JET BOUNDARIES
Wind forcing experiments in the California current system
[AD-A176818] N87-21545

JET ENGINE FUELS
Techniques to determine particulates in liquid fuels
[DE87-002028] N87-21135

JET ENGINES
Performance test of 110 mm bore ball bearing made from corrosion resistant powdered steel
[AD-A177060] N87-21342

JOINTS (JUNCTIONS)
Interferometric measurement of strains and displacements in engine components N87-21196
Nonlinear viscoelastic analysis of adhesively bonded joints
[AD-A176494] N87-21379
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387

JOSEPHSON JUNCTIONS
Vortices in long Josephson junctions
[AD-A176916] N87-21695
Period three generation on microwave-induced constant-voltage steps of Josephson tunnel junctions
[DE87-003530] N87-21700
Field effect and Josephson junction
[DE87-004473] N87-21701
Nature of coupling and dimensional crossover in superconducting multilayers
[DE87-004676] N87-21706
Superconducting properties of compositionally modulated Pb/Ge thin films
[DE87-004679] N87-21708

JUPITER ATMOSPHERE
Ultraviolet observations of Jupiter and Uranus N87-21762

JUPITER RED SPOT
Ultraviolet observations of Jupiter and Uranus N87-21762

JUPITER SATELLITES
Spectral reflectance (0.4 - 5.0 microns) of sulfur related compounds and mixtures
[NASA-CR-180525] N87-21781

K

KEROSENE
Development of a large-scale antimisting kerosene blender
[AD-A176997] N87-21134

KEVLAR (TRADEMARK)
Multi-axial failure criteria in fiber composites and their application to the through-thickness strength of hybrid fiber laminates N87-21040

KINETIC ENERGY
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048
Comparative study of several cases of Alpine lee-cyclogenesis: Kinetic energy and vorticity N87-21512

KINETICS
Measurement of fatigue crack growth kinetics of Copper-Kapton laminates by dynamic mechanical thermal analysis
[DE87-003024] N87-21390
Kinetics and thermodynamics of quasicrystals as determined by surface modification techniques
[DE87-005538] N87-21713

KNOWLEDGE
Artificial intelligence techniques for working with knowledge
[NLR-MP-85037-U] N87-21621
Providing knowledge by means of artificial intelligence techniques: Experiences and developments at the National Aerospace Laboratory (NLR)
[NLR-MP-85061-U] N87-21622
Activities report of the Information Systems Department
[FOA-C-30441-3.3] N87-21745

KRYPTON FLUORIDE LASERS
Layered target burnthrough experiments using 50 nsec KrF laser pulses
[DE87-005111] N87-21329

L

LABORATORIES
Application of a high-precision universal measuring machine in Standards Laboratory measurements
[DE87-003036] N87-21308
Geophysical Fluid Dynamics Laboratory activities FY86, plans FY87
[PB87-134458] N87-21403

LAKES
Results of the Alpine Experiment (ALPEX) aircraft intercomparison on 19 April 1982 N87-21493

LAMINAR FLOW
Simultaneous temperature measurements with Raman and CARS in laminar flames N87-21171
Computer-aided analysis of two-dimensional laminar and turbulent incompressible flows N87-21256
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions
[NASA-CR-180272] N87-21303
Stratified flow and wave motion near mountain tops N87-21514
Laboratory simulation of rotating stratified flow over and around the Alps N87-21516

LAMINATES
Multi-axial failure criteria in fiber composites and their application to the through-thickness strength of hybrid fiber laminates N87-21040
A comparison of the fatigue performance of woven and non-woven CFRP laminates [RAE-TR-85059] N87-21041
The micromechanics of damage initiation and development under static and fatique loading of CFRP XA-S/914 and E-glass/913 laminates [BR-99965] N87-21044
The effects of impact damage in tapered-thickness CFRP laminates [RAE-TR-85087] N87-21045
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates [AD-A176474] N87-21048
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Part A: Adhesion and delamination [ETN-87-99576] N87-21056
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination [ETN-87-99577] N87-21057
Failure strengths of laminated glass units [PB87-118873] N87-21113
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
Convergence of strain energy release rate components for edge-delaminated composite laminates [NASA-TM-89135] N87-21377
Measurement of fatigue crack growth kinetics of Copper-Kapton laminates by dynamic mechanical thermal analysis [DE87-003024] N87-21390
Artificially structured superconductors [DE87-004007] N87-21714
LANDAU FACTOR
Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems [PREPRINT-542] N87-21674
LARGE SPACE STRUCTURES
Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] N87-21021
Measurement apparatus and procedure for the determination of surface emissivities [NASA-CASE-LAR-13455-1] N87-21206
LASER ANEMOMETERS
Laser fringe anemometry for aero engine components N87-21176
Seeding gas flows for laser anemometry N87-21178
Application of Doppler and transit laser anemometry in small turbomachines N87-21180
Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility N87-21183
Use of laser-Doppler-anemometry for the measurement of velocity distributions at the intake of a longitudinal flow heat exchanger [JUEL-SPEZ-362] N87-21293
LASER ANNEALING
Phase selection during pulsed laser annealing of Fe-V alloys [DE87-003507] N87-21318
Pulsed excimer laser processing for cost-effective solar cells [NASA-CR-180528] N87-21413
LASER APPLICATIONS
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
Laser microfabrication technology and its application to high speed interconnect of gate arrays [DE87-004363] N87-21320
LLE review [DE87-005865] N87-21324
An Overview of the Lawrence Livermore National Laboratory Free Electron Laser Program [DE87-005815] N87-21330
Physics at the laser-atomic frontier [PB87-126811] N87-21646
LASER DOPPLER VELOCIMETERS
Laser Doppler velocimeter measurements in a turbulent junction vortex N87-20964
Advanced Instrumentation for Aero Engine Components [AGARD-CP-399] N87-21170
Laser-2 focus velocimetry N87-21177
How to select a laser velocimeter for a given application? N87-21179
Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor N87-21181
Evaluation of L2F-measurements in unsteady turbine flow N87-21182
Velocity and temperature measurements in a can-type gas-turbine combustor N87-21184
The flow around a squared obstacle N87-21185
Processing techniques for correlation of LDA and thermocouple signals N87-21194
Use of laser-Doppler-anemometry for the measurement of velocity distributions at the intake of a longitudinal flow heat exchanger [JUEL-SPEZ-362] N87-21293
LASER FUSION
Muonic X-ray laser assisted by catalyzed fusion of deuterium and tritium [DE87-004651] N87-21327
LASER HEATING
Picosecond laser pulse interactions with metallic and semiconductor surfaces [AD-A176645] N87-21067
LASER INTERFEROMETRY
Vibration analysis by speckle interferometry N87-21197
The improvement and evaluation of a laser interferometer for the absolute measurement of ultrasonic displacements in the frequency range up to 15 MHz — hydrophones [NPL-AC-109] N87-21311
The absolute measuring accuracy of technical laser interferometers [ETN-87-99580] N87-21331
LASER MODE LOCKING
A simple method for electronic feedback stabilization of an actively modelocked and Q-switched Nd:YLF laser [DE87-002823] N87-21325
LASER OUTPUTS
Performance of two coupled lasers [AD-A177185] N87-21312
A self-similar approach to the explosion of droplets by a high energy laser beam [DE87-005124] N87-21322
LASER PLASMAS
LLE review [DE87-005865] N87-21324
LASER PROPULSION
Experimental and theoretical studies of laser propulsion phenomenology [AD-A176851] N87-21315
LASER PUMPING
Performance of two coupled lasers [AD-A177185] N87-21312
LASER SPECTROMETERS
The study of combustion by means of diode laser spectroscopy N87-21201
LASER STABILITY
Performance of two coupled lasers [AD-A177185] N87-21312
LASER TARGET INTERACTIONS
Short wavelength laser/materials interactions [AD-A176950] N87-21316
LASER TARGETS
An overview of the long pulse experiment [DE87-003738] N87-21326
LASER WELDING
Laser welding metallography [DE87-004113] N87-21348
LASERS
Compressive properties and laser absorptivity of unidirectional metal matrix composites [AD-A176194] N87-21046
Turbulent premixed flame study [DE87-006255] N87-21066
A laser Doppler method for noninvasive measurement of flow velocity [DE87-005197] N87-21283
Saturation effects in coupled lasers with homogeneous gain [AD-A176843] N87-21314
Laser light-scattering and laser fluorescence studies of solvent extraction systems [DE87-003910] N87-21321
A 1-ms electron beam facility for laser kinetic studies [DE87-003299] N87-21323
An overview of the long pulse experiment [DE87-003738] N87-21326
Using vision systems when bar code won't work [DE87-004514] N87-21740
LATCHES
Self indexing latch system [NASA-CASE-MFS-25956-1] N87-21333
LATE STARS
Using nonradial pulsations to determine the envelope composition of very evolved stars [DE87-001982] N87-21765
LATERAL CONTROL
Prediction of the aerodynamic characteristics of cruciform missiles including effects of roll angle and control deflection [AD-A176553] N87-21010
LATTICES (MATHEMATICS)
The octet nonleptonic Hamiltonian and current algebra on the lattice with Wilson fermions [PREPRINT-525] N87-21636
LEAD (METAL)
Superconducting properties of compositionally modulated Pb/Ge thin films [DE87-004679] N87-21708
LEAD TITANATES
Lead titanates: Electromechanical anisotropic materials applicable to electroacoustic instrumentation [INSA-IDI1-8603] N87-21068
LEADING EDGES
An approach to practical aerodynamic calculations [AD-A176995] N87-20970
Transonic compressor blade tip flow visualization on a water table [AD-A176592] N87-21285
LEAKAGE
Approach to evaluating leak detection methods in underground storage tanks [PB87-118444] N87-21168
LEARNING
On learning boolean functions [AD-A176516] N87-21626
LEAST SQUARES METHOD
Nonlinearity and single shot noise problems in CARS spectroscopy N87-21174
LEE WAVES
Alpine lee cyclogenesis: Numerical simulation and theory N87-21498
A theory of deep cyclogenesis in the lee of the Alps: Modification of baroclinic instability by topography N87-21499
A normal mode nongeostrophic model of lee cyclogenesis N87-21501
Numerical simulation of lee cyclogenesis during Alpine Experiment with an isentropic coordinate model N87-21504
The role of Alps mountains representation in the lee cyclogenesis simulation N87-21505
Comparative study of several cases of Alpine lee-cyclogenesis: Kinetic energy and vorticity N87-21512
Effects of terrain height and blocking initialization on numerical simulation of Alpine lee cyclogenesis N87-21515
LENS DESIGN
Computer aided design of magnetic deflection systems [ETN-87-99583] N87-21608
LIAPUNOV FUNCTIONS
The relevance of connectance on the Lyapunov characteristic exponents of products of symplectic random matrices [PREPRINT-519] N87-21643
LIBRATIONAL MOTION
Raman spectra of water in the translational and librational regions. Part 1: Study of the depolarization ratio [PREPRINT-534] N87-21071
LIFE SUPPORT SYSTEMS
Maintenance evaluation for space station liquid systems N87-21155
LIFT
Experimental studies on the dynamic development and control of unsteady separated flows [AD-A176376] N87-20969
LIFTING REENTRY VEHICLES
A theoretical examination of a reentry capsule incorporating an autorotating rotor [AD-A176854] N87-21026
LIFTING ROTORS
A theoretical examination of a reentry capsule incorporating an autorotating rotor [AD-A176854] N87-21026
LIGHT AIRCRAFT
Light aircraft maintenance. General guidance on implementation of the Light Aircraft Maintenance Scheme (LAMS), for aircraft not exceeding 2730 kg MTWA, with a certificate of airworthiness in the transport, aerial work or private category [CAP-520] N87-20954
LIGHT EMISSION
The 2-4 semiconductor superlattices [AD-A177092] N87-21696
LIGHT MODULATION
Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year-1 [AD-A176839] N87-21681
LIGHT SCATTERING
Laser-2 focus velocimetry N87-21177
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205

Evaluation of Brillouin scattering intensities from rare gas crystals. Part 1: A pure dipole induced dipole theory
[PREPRINT-535] N87-21722

LIGHT TRANSMISSION
Liquid-core fiber optics: Transmission and nonlinear effects
[DE87-005960] N87-21683

LINE SPECTRA
Optical scanner
[NASA-CASE-GSC-12897-1] N87-21679
Astronomical observations of the 807 GHz CO J = 7-6 rotational line with a new heterodyne spectrometer N87-21759
Spectral reflectance (0.4 - 5.0 microns) of sulfur related compounds and mixtures
[NASA-CR-180525] N87-21781
Comparison of solar hard X-ray and UV line and continuum bursts with high time resolution N87-21813

LINEAR ACCELERATORS
An Overview of the Lawrence Livermore National Laboratory Free Electron Laser Program
[DE87-005815] N87-21390

LINEAR EQUATIONS
The binary weight distribution of the extended (2 sup m, 2 sup m-4) code of Reed-Solomon code over GF(2 sup m) with generator polynomial (x-alpha sup 2) (x-alpha sup 3)
[NASA-CR-180510] N87-21625

LIPIDS
Change in bile acid and lipid content of human bile during exposure to antiorthostatic hypokinesia and its correction N87-21565

LIQUID CHROMATOGRAPHY
Supercritical fluid chromatography of polar organic compounds in combustion particulates
[PB87-126645] N87-21073

LIQUID FILLED SHELLS
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262

LIQUID FUELS
Investigation of the characteristics of liquid fuel burning, Rijke type, pulsating combustors
[DE87-001931] N87-21063
Techniques to determine particulates in liquid fuels
[DE87-002028] N87-21135
Overview: Fluid acquisition and transfer N87-21146

LIQUID HELIUM
Helium technology issues N87-21145
Superfluid helium on orbit transfer (SHOOT) N87-21151
Flow properties of He3 in dilute He3-He4 mixtures at temperatures between 10 and 150 mK
[ETN-87-99582] N87-21300
Pool type liquid helium cryopump
[DE87-701268] N87-21349
Research on cryogenic vacuum tunneling
[AD-A176390] N87-21662

LIQUID HYDROGEN
Ten degree Kelvin hydride refrigerator
[NASA-CASE-NPO-16393-1-CU] N87-21159

LIQUID METAL FAST BREEDER REACTORS
Behavior of UO2 and fission in sodium vapor atmosphere at temperatures up to 2600 C — reactor core disassembly
[KFK-4135] N87-21677

LIQUID PHASE EPITAXY
Diffusion and defect characterization of mercury cadmium telluride
[AD-A176323] N87-21690

LIQUID ROCKET PROPELLANTS
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039
Shuttle get-away special experiments N87-21157

LIQUID SLOSHING
The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement N87-21147

LIQUID-LIQUID INTERFACES
Turbulent energy generated by accelerations and shocks
[DE87-002377] N87-21274
Laser light-scattering and laser fluorescence studies of solvent extraction systems
[DE87-003910] N87-21321

LIQUIDS
Viscosity behavior in supercooled pure liquids and mixtures
[DE87-004036] N87-21282
Mixing in a double-diffusive, partially stratified fluid
[DE87-001131] N87-21285
Liquid-core fiber optics: Transmission and nonlinear effects
[DE87-005900] N87-21683

LITHIUM
Proceedings of the International Workshop on High-Temperature Molten Salt Batteries
[DE87-003297] N87-21248
Theoretical investigations of releases of lithium in the Earth's magnetosphere
[AD-A177080] N87-21437

LIVER
Change in bile acid and lipid content of human bile during exposure to antiorthostatic hypokinesia and its correction N87-21565

LOADS (FORCES)
Dual motion valve with single motion input
[NASA-CASE-MFS-28056-1] N87-21332
Improvement of fatigue life prediction accuracy for various realistic loading spectra by use of correction factors
[TAE-581] N87-21374

LOGIC CIRCUITS
Macromodeling of digital circuits
[AD-A176874] N87-21243

LONG DURATION SPACE FLIGHT
Mars Observer: Phase 0 safety review data package
[NASA-CR-180526] N87-21019
Space station experiment definition: Long term cryogenic fluid storage N87-21144

LONG RANGE WEATHER FORECASTING
Weather regimes and mountain effects in general circulation models: Implications for extended range weather forecasts N87-21513

LONG TERM EFFECTS
Group dynamics and performance efficiency under extreme conditions N87-21578

LONGITUDINAL CONTROL
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004

LOOPS
Exploiting loop level parallelism in nonprocedural dataflow programs
[NASA-CR-178277] N87-21613

LORAN C
LORAN-C tetroon transponder and tracking system
[PB87-116687] N87-20987

LOSSES
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
On the mass loss rate by the nuclei of planetary nebulae
[DE87-701325] N87-21777

LOW ALTITUDE
Ground Proximity Warning System (GPWS): Guidance material
[CAP-516] N87-20977
Tethered balloon measurements made at Naval Air Development Center (December 1985)
[AD-A176254] N87-21517

LOW CARBON STEELS
Design of low carbon dual-phase steels for high strength wire
[DE87-006169] N87-21104

LOW FREQUENCIES
A numerical method for solving for normal modes with impedance bottom
[AD-A176591] N87-21540

LOW PRESSURE
CARS thermometry for low and high pressure combustion systems N87-21172
Report on the calibration of two spinning-rotor gauges for the BIPM very low pressure intercomparison — Bureau International des Poids et Mesures (BIPM)
[NPL-MOM-80] N87-21305

LOW SPEED
Size and shape of solid fuel diffusion flames in very low speed flows
[NASA-CR-179576] N87-21129

LOW TEMPERATURE PHYSICS
Flow properties of He3 in dilute He3-He4 mixtures at temperatures between 10 and 150 mK
[ETN-87-99582] N87-21300

LOWER BODY NEGATIVE PRESSURE
Mechanism of action of local negative pressure applied to human body on dynamics of central circulation N87-21579

LUBRICANT TESTS
Assessment of remaining lubricant life
[AD-A177186] N87-21121

LUBRICATING OILS
Assessment of remaining lubricant life
[AD-A177186] N87-21121

M

MAGNESIUM
Localized plasticity of graphite/magnesium metal matrix composites
[DE87-004542] N87-21053
Ice-melting characteristics of calcium magnesium acetate
[PB87-122123] N87-21167
Theoretical and observational review of results on nova explosions occurring on ONeMg white dwarfs
[DE87-001962] N87-21772

MAGNESIUM ALLOYS
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys
[AD-A176970] N87-21089

MAGNESIUM COMPOUNDS
Origin of cracking phenomena observed in decomposition reactions
[DE87-000199] N87-21392

MAGNET COILS
SC correction coils and magnets for the HERA proton ring
[NIKHEF-H/86-10] N87-21676

MAGNETIC FIELD CONFIGURATIONS
Rapid fluctuations in solar flares N87-21786

MAGNETIC FIELDS
Experimental results from railgun firings involving magnetic flux probes
[MRL-TN-509] N87-21008
Progress toward predicting high-voltage charging of spacecraft in low polar orbit
[AD-A176939] N87-21027
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217
Theoretical investigations of releases of lithium in the Earth's magnetosphere
[AD-A177080] N87-21437
Observations and theory of the AMPTE (Active Magnetospheric Particle Tracer Explorers) magnetotail barium releases
[DE87-006325] N87-21440
Reactivity of adrenosympathetic system and tolerance to exercise load during repeated exposure to stationary magnetic field N87-21573
Direct and indirect effects of stationary magnetic field on biological systems N87-21574
Radiosensitivity of escherichia coli following irradiation in a stationary magnetic field N87-21582
On the numerical modelling of a magnetic source
[ARE-TR-86113] N87-21647
The interchange instability in high-latitude plasma blobs
[AD-A176242] N87-21685
Superlattice effects in graphite intercalation compounds
[AD-A176879] N87-21694
The comet Giacobini-Zinner magnetotail: Axial stresses and inferred near-nucleus properties
[DE87-003712] N87-21775
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784

MAGNETIC FLUX
The magnetic flux contributed by the plasma armature in an electromagnetic launcher
[MRL-R-1033] N87-21009

MAGNETIC LENSES
Computer aided design of magnetic deflection systems
[ETN-87-99583] N87-21608

MAGNETIC MATERIALS
Analysis of the magnetic properties of semimagnetic semiconductors. An experimental study
[ETN-87-99579] N87-21720

MAGNETIC MEASUREMENT
On the numerical modelling of a magnetic source
[ARE-TR-86113] N87-21647

MAGNETIC MOMENTS
Magnetic moments of multiquark states and limit on the six-quark bag admixture in the deuteron wave function
[PREPRINT-537] N87-21673

MAGNETIC PROPERTIES
Analysis of the magnetic properties of semimagnetic semiconductors. An experimental study
[ETN-87-99579] N87-21720

MAGNETIC SIGNATURES
Signatures of current loop coalescence in solar flares N87-21827
MAGNETOHYDRODYNAMIC FLOW
Nonequilibrium in flowing atmospheric plasmas [ETN-87-99587] N87-21688
MAGNETOHYDRODYNAMIC STABILITY
Electron-cyclotron maser emission during flares: Emission in various modes and temporal variations N87-21821
Theoretical studies on rapid fluctuations in solar flares N87-21830
MAGNETOHYDRODYNAMIC WAVES
Plasma physics abstracts, 1 January - 31 December, 1986 [NASA-CR-180220] N87-21684
Impulsively generated fast coronal pulsations N87-21822
MAGNETOHYDRODYNAMICS
Pick-up ion trajectories in a comet model [AD-A176618] N87-21770
MAGNETOMETERS
Fluxgate magnetometer analysis and simulation software for the Combined Release and Radiation Effects Satellite (CRRES) [AD-A176353] N87-21032
MAGNETOSPHERE
Theoretical investigations of releases of lithium in the Earth's magnetosphere [AD-A177080] N87-21437
Observations and theory of the AMPTE (Active Magnetospheric Particle Tracer Explorers) magnetotail barium releases [DE87-006325] N87-21440
Solar wind plasma in the magnetosphere method of entry and consequences [AD-A177255] N87-21835
MAINTENANCE
Maintenance evaluation for space station liquid systems N87-21155
Handbook for operation and maintenance of an NBS (National Bureau of Standards) multisensor automated EM (electromagnetic) field measurement system [PB87-140729] N87-21749
MAN MACHINE SYSTEMS
Automatic processing system for shadowgraph and interference patterns [NASA-TM-88525] N87-21307
Theoretical development for identifying underlying internal processes. Volume 1. The theory of underlying internal processes [AD-A176466] N87-21588
MAN-COMPUTER INTERFACE
FY86 independent research/independent exploratory development [AD-A176944] N87-21589
The X window system [AD-A176476] N87-21604
MANAGEMENT INFORMATION SYSTEMS
University program management information system, fiscal year 1986. [PB87-127379] N87-21736
MANAGEMENT METHODS
Block 2 SRM conceptual design studies. Volume 1, Book 2: Preliminary development and verification plan [NASA-CR-179054] N87-21036
MANGANESE ALLOYS
Kinetics and thermodynamics of quasicrystals as determined by surface modification techniques [DE87-005538] N87-21713
MANIPULATORS
On impact dynamics of robotic operations [AD-A176464] N87-21337
Modeling and experimental validation of a single-link flexible manipulator [AD-A176614] N87-21338
The near-minimum time control of a robot arm [AD-A176875] N87-21339
Advanced manipulation for autonomous mobile robots [DE87-002818] N87-21351
Mobile robots in research and development programs at the Savannah River site [DE87-003114] N87-21352
Modeling and control of the Stanford/JPL hand [DE87-005847] N87-21353
Manipulator Comparative Testing Program [DE87-006026] N87-21355
Preliminary development head-neck simulator. Volume 2: Mathematical simulations [PB87-142196] N87-21557
A flexible, computer-integrated robotic transfer system [DE87-004183] N87-21619
MANNED SPACE FLIGHT
USSR Report: Space Biology and Aerospace Medicine, Volume 20, No. 6, November - December 1986 [JPRS-USB-87-001] N87-21558
Effect of spaceflight factors on hemopoiesis N87-21560
MANUFACTURING
Net shape technology in aerospace structures. Volume 1 [AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California [AD-A176509] N87-20958
MAPPING
The Universal Transverse Mercator grid formulas for cartographic applications programmers [AD-A176624] N87-21407
Quick look Atlantic Ocean rain maps for gale [NASA-CR-180511] N87-21533
Characteristics of the two-dimensional spectrum of roughness on a seamount [AD-A176366] N87-21538
A coordinate conversion algorithm for multisensor data processing [AD-A176368] N87-21603
Evidence for beamed electrons in a limb X-ray flare observed by Hard X-Ray Imaging Spectrometer (HXIS) N87-21791
MARINE ENVIRONMENTS
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery [AD-A176628] N87-21519
MARINE METEOROLOGY
Mariners weather log, volume 30, number 4, Fall 1986 [PB87-129417] N87-21526
Marine environmental assessment: Chesapeake Bay, December 1985 - February 1986 [PB87-129458] N87-21531
MARINE RESOURCES
Directory of MIT (Massachusetts Institute of Technology) Sea Grant College Program publications, 1978-1986 [PB87-137105] N87-21550
MARS (PLANET)
Mars Observer: Phase 0 safety review data package [NASA-CR-180526] N87-21019
MARTENSITE
Design of dual phase steels for bars and rods [DE87-003535] N87-21093
MARTENSITIC STAINLESS STEELS
Design of low carbon dual-phase steels for high strength wire [DE87-006169] N87-21104
MASER OUTPUTS
Electron-cyclotron maser emission during flares: Emission in various modes and temporal variations N87-21821
MASERS
Millimeter wave generation by relativistic electron beams [AD-A176949] N87-21245
MASKS
Ion beam sputter etching [NASA-CASE-LEW-13899-1] N87-21160
MASS
Microstructural investigation of copolymers. A key in revealing relations between polymerization conditions and polymer properties [ETN-87-99585] N87-21127
Neurohumoral and mechanical factors in the modulation of left ventricular mass [NASA-CR-180524] N87-21554
The gravitational properties of antimatter [DE87-003367] N87-21725
MASS FLOW RATE
A correlation for the heat transfer coefficient in a rectangular passage containing protuberance [AD-A176111] N87-21261
MASS SPECTROSCOPY
Advanced B and Al combustion kinetics studies over wide temperature ranges [AD-A176828] N87-21061
MASS TRANSFER
Quasi-Lagrangian diagnostics of a Mediterranean cyclone: Isentropic results N87-21507
MATERIALS HANDLING
A flexible, computer-integrated robotic transfer system [DE87-004183] N87-21619
Materials Information for Science and Technology (MIST): Project overview [PB87-136877] N87-21750
MATHEMATICAL MODELS
On the modelling of non-reactive and reactive turbulent combustor flows [NASA-CR-4041] N87-20996
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration [AD-A176333] N87-21004
Numerical modelling of cryogenic propellant behavior in low-G N87-21148
Analysis and restitution of voice signals using evolving models [ENST-86E009] N87-21226
Battery thermal modeling: The methodology and applications [DE87-004865] N87-21249
Heat transfer in oscillatory flow [DE87-004374] N87-21276
Development of a two-equation turbulent mix model [DE87-005837] N87-21284
Numerical boundary conditions with minimal reflection for limited-area models [KNMI-WR-86-3] N87-21292
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 2: Manifestations of the mechanisms related to large oriented structures in homogeneous turbulence. Part A: Experimental study. Part B: Theoretical study [ETN-87-99395] N87-21294
The near-minimum time control of a robot arm [AD-A176875] N87-21339
Modeling and control of the Stanford/JPL hand [DE87-005847] N87-21353
Mathematical and numerical study of a single side contact friction problem in elasticity and elastoplasticity [ECL-85-09] N87-21358
Some research problems in reliability theory and in limit theory [AD-A176439] N87-21363
Ultrasonic detection of weld bead geometry [DE87-000441] N87-21366
Alpine lee cyclogenesis: Numerical simulation and theory N87-21496
The role of Alps mountains representation in the lee cyclogenesis simulation N87-21505
Effects of terrain height and blocking initialization on numerical simulation of Alpine lee cyclogenesis N87-21515
Preliminary development head-neck simulator. Volume 2: Mathematical simulations [PB87-142196] N87-21557
Mathematical model of the otolith N87-21572
A method for the construction of continuously differentiable surfaces for the interpolation of scattered data [HMI-B371] N87-21628
The estimation of parameters in functional relationship models [ETN-87-99586] N87-21630
The multifractal nature of strange attractors and turbulence [PREPRINT-539] N87-21640
On the numerical modelling of a magnetic source [ARE-TR-86113] N87-21647
Modeling turbulence-induced noise with application to noise control [AD-A176417] N87-21655
Interpretation of rapid rises in hard X-rays and microwaves with the thermal conduction front model N87-21788
MATRICES (MATHEMATICS)
Structure theories and applications of multivariable control systems described by block canonical forms [AD-A176482] N87-21615
The relevance of connectance on the Lyapunov characteristic exponents of products of symplectic random matrices [PREPRINT-519] N87-21643
MATRIX MATERIALS
Net shape technology in aerospace structures. Volume 1 [AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland [AD-A176511] N87-20960
Multi-axial failure criteria in fiber composites and their application to the through-thickness strength of hybrid fiber laminates N87-21040
MAXIMUM ENTROPY METHOD
Application of the maximum entropy principle to retrieval from very large databases [PB87-115523] N87-21752
MAXIMUM PRINCIPLE
Maximum principle for viscous fluids flowing through regions of pure fluid and mixtures [DE86-780543] N87-21277

MAXWELL EQUATION
Original improvements of the TLM method
[RAE-TRANS-2151] N87-21624
MEASURING INSTRUMENTS
Tip clearance measurement in modern compressor components N87-21199
Compressor blade clearance measurement using capacitance and phase lock techniques N87-21200
Application of a high-precision universal measuring machine in Standards Laboratory measurements
[DE87-003036] N87-21306
Operations handbook-ozone measurements to 40-km altitude with Model 4A Electrochemical Concentration Cell (ECC) ozonesonses (used with 1680-MHz radiosondes)
[PB87-113874] N87-21426
Handbook for the Quality Assurance of Meteorological measurements
[PB87-140422] N87-21452
MECHANICAL DEVICES
Self indexing latch system
[NASA-CASE-MFS-25956-1] N87-21333
MECHANICAL DRIVES
Dual motion valve with single motion input
[NASA-CASE-MFS-28058-1] N87-21332
MECHANICAL ENGINEERING
Introduction to the development of automation plans for Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) in mechanical engineering
[NLR-MP-85042-U] N87-21606
MECHANICAL PROPERTIES
Mechanical properties of elementally blended Ti-6Al-4V
[AD-A176640] N87-21086
Design of dual phase steels for bars and rods
[DE87-003595] N87-21093
Processing and properties of powder metallurgy Ni(sub 3)Al-Cr-Zr-B for use in oxidizing environments
[DE87-001690] N87-21101
Grain-boundary modeling
[DE87-004737] N87-21710
MEDITERRANEAN SEA
The Mediterranean-Alpine Experiment (MED-ALPEX) data set N87-21489
On the synoptics and dynamics of orographically induced cyclones in the Mediterranean N87-21506
Quasi-Lagrangian diagnostics of a Mediterranean cyclone: Isentropic results N87-21507
Nonalpine contribution to Mediterranean cyclogenesis: Synoptic study of two cases which occurred during Alpine Experiment (ALPEX) Special Observing Period N87-21510
MELLIN TRANSFORMS
A class of integral transforms and associated function spaces
[ETN-87-99575] N87-21629
MELTING
Analysis of picosecond pulsed laser melted graphite
[DE87-003755] N87-21124
MELTS (CRYSTAL GROWTH)
Large area sheet task: Advanced dendritic web growth development
[NASA-CR-180505] N87-21417
Three-dimensional numerical studies of the physics of semiconductor crystal growth
[AD-A176606] N87-21693
MEMBRANES
Fluctuations in membranes with crystalline and hexatic order
[PREPRINT-538] N87-21402
MEMORY (COMPUTERS)
Algorithm implementation on the Navier-Stokes computer
[NASA-TM-89119] N87-20968
MERCATOR PROJECTION
The Universal Transverse Mercator grid formulas for cartographic applications programmers
[AD-A176624] N87-21407
MERCURY CADMIUM TELLURIDES
Diffusion and defect characterization of mercury cadmium telluride
[AD-A176323] N87-21690
Application of the ALE and MBE methods to the growth of layered Hg sub 1-x Cd sub x Te films
[AD-A176797] N87-21692
MERCURY TELLURIDES
Diffusion and defect characterization of mercury cadmium telluride
[AD-A176323] N87-21690
MESON-MESON INTERACTIONS
Neutral meson decays and the annihilation contribution
[PREPRINT-515] N87-21666
MESONS
Joint production of phi mesons and pi(+,-), pi(0), rho, rho bar, K(0)S and K(+,-) in hadronic interactions
[NIKHEF-H/86-2] N87-21663
MESOSCALE PHENOMENA
Convective scale interaction: Arc cloud lines and the development and evolution of deep convection N87-21424
A numerical investigation of an orogenic mesoscale convective system N87-21425
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
METABOLISM
EWAM: A model for predicting food and water ingestion, and inhalation rates of man
[DE86-900117] N87-21590
METAL AIR BATTERIES
Aluminum-air battery crystallizer
[DE87-005839] N87-21252
METAL BONDING
Development of the diffusion bonding process
[DE87-006596] N87-21164
Study of ceramic-metal bonding: Application to copper-alumina bonding
[ECL-86-13] N87-21360
METAL COATINGS
Method for forming hermetic seals
[NASA-CASE-NPO-16423-1-CU] N87-21334
METAL COMBUSTION
Advanced B and Al combustion kinetics studies over wide temperature ranges
[AD-A176826] N87-21061
METAL FATIGUE
Defect and damage characterization in composite materials
[AD-A176335] N87-21047
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE87-006152] N87-21103
Fracture properties of ferritic, ferritic-pearlitic, pearlitic and bainitic nodular cast irons
[VTT-430] N87-21110
METAL FILMS
Method for forming hermetic seals
[NASA-CASE-NPO-16423-1-CU] N87-21334
METAL HYDRIDES
Metal hydride temperature amplifiers for high temperature (260 C) applications: A parametric study
[DE87-005297] N87-21415
METAL IONS
Laser light-scattering and laser fluorescence studies of solvent extraction systems
[DE87-003910] N87-21321
METAL MATRIX COMPOSITES
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
Plasma joining of metal matrix composites
[AD-A176690] N87-21042
Compressive properties and laser absorptivity of unidirectional metal matrix composites
[AD-A176194] N87-21046
Defect and damage characterization in composite materials
[AD-A176335] N87-21047
Localized plasticity of graphite/magnesium metal matrix composites
[DE87-004542] N87-21053
Ultimate tensile strength of pitch-based carbon fibers
[AD-A176955] N87-21118
METAL NITRIDES
The effect of ion damage and annealing on superconducting transition metal-nitride compounds
[DE87-005988] N87-21712
METAL OXIDE SEMICONDUCTORS
Contribution to understanding and modeling hot carrier injection phenomena in submicron MOS devices
[ECL-86-12] N87-21717
METAL OXIDES
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces
[AD-A176445] N87-21691
METAL PLATES
Effects of irradiation on the fracture toughness of Alloy 718 plate and weld
[DE87-004345] N87-21102
METAL POWDER
Densification of titanium powder during hot isostatic pressing
[AD-A176617] N87-21084
Performance test of 110 mm bore ball bearing made from corrosion resistant powdered steel
[AD-A177060] N87-21342
METAL SHEETS
Impact verification of space suit design for space station
[NASA-CR-180456] N87-21584
METAL SURFACES
Picosecond laser pulse interactions with metallic and semiconductor surfaces
[AD-A176645] N87-21087
Method for forming hermetic seals
[NASA-CASE-NPO-16423-1-CU] N87-21334
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces
[AD-A176445] N87-21691
METALLOGRAPHY
High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms
[AD-A176211] N87-21079
Creep cavitation in a nickel aluminide
[DE87-004392] N87-21106
METALS
Stage 4 work hardening in cubic metals
[DE87-003756] N87-21094
On the correlation of hardness with tensile and yield strength
[VTT-416] N87-21109
Turbine rotor blade measurements using infrared pyrometry N87-21188
The application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce N87-21198
Thermomechanical effects in inelastic materials and structures
[AD-A177076] N87-21386
Computer simulation of special grain boundaries in metals and ionic materials
[DE87-004989] N87-21707
Grain-boundary modeling
[DE87-004737] N87-21710
Artificially structured superconductors
[DE87-004007] N87-21714
METASTABLE STATE
Tetrahydrogen
[AD-A176778] N87-21133
METEOR TRAILS
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176662] N87-21433
METEORITIC COMPOSITION
Laser microprobe studies of rare gas isotopes in meteorites N87-21769
METEOROIDS
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176662] N87-21433
METEOROLOGICAL FLIGHT
Proceedings of the Meteorological Motor Glider (MEMO) Workshop
[ESA-TT-945] N87-21453
Motor glider meteorology N87-21454
Typical and historical aspects of motor gliders as meteorological measuring aircraft N87-21455
A comparison between Falcon data and motor glider data N87-21456
Case studies for flux measurements along a low-flying route to the south of Munich N87-21459
Environmental-physical measurements and determination of atmospheric turbulence with the ASK-16 motor glider N87-21460
Measurements of the vertical structure of the convective boundary layer N87-21461
Aircraft measurements during the Bonn Experiment (BONEX 1) — atmospheric boundary layer N87-21463
Motor glider measurements during the urban atmosphere energy budget experiment (EESA 1) N87-21464
Meteorological measurements with motor gliders in Poland N87-21466
Principles of wind measurement with the help of aircraft N87-21469
The Aircraft to Satellite Data Relay: ASDAR N87-21478
Navigational Aid (NAVAID) vertical sounding system — atmospheric sounding N87-21479
Results of the Alpine Experiment (ALPEX) aircraft intercomparison on 19 April 1982 N87-21493
Vertical air motion and turbulence parameters from commercial aircraft N87-21494
METEOROLOGICAL PARAMETERS
Effective removal parameters in long-range transport models, derived from diffusion theory calculations — air pollution
[ECN-187] N87-21419

Atmospheric climate data: Problems and promises
[NASA-CR-180442] N87-21450
Monthly and Seasonal Weather Outlook for November 1986, Volume 40, Number 21, October 30, 1986
[PB87-118980] N87-21451
Meteorological parameters derived from space-based observing systems, during the Global Weather Experiment and after N87-21475
A variational objective analysis scheme for analysis of the ALPEX data set — Alpine Experiment (ALPEX) N87-21491

METEOROLOGICAL SATELLITES
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432
Meteorological parameters derived from space-based observing systems, during the Global Weather Experiment and after N87-21475
Automatic mobile platforms — meteorological buoys N87-21477
The Aircraft to Satellite Data Relay: ASDAR N87-21478

METEOROLOGICAL SERVICES
Management of automation projects that are relevant for the Royal Dutch Meteorological Institute (KNMI)
[NLR-MP-85075-U] N87-21734

METEOROLOGY
Developments in air traffic control systems and their relation with meteorology
[RAE-TRANS-2143] N87-20981
Atmospheric transport and dispersion of pollutants and related meteorological studies: Program summary
[DE87-005644] N87-21418

METEOSAT SATELLITE
Meteosat contribution to Alpine Experiment (ALPEX): Highlights and limits N87-21495

METRIC SPACE
Inflation in spherically symmetric inhomogeneous models
[DE87-005405] N87-21779

METROLOGY
Activities report in electrical technology
[ETN-87-99354] N87-21253
Handbook for the Quality Assurance of Meteorological measurements
[PB87-140422] N87-21452
Technical activities 1986, Center for Basic Standards
[PB87-140315] N87-21651
Technical publication announcements covering Center programs, January to March 1986
[PB87-140273] N87-21748

MICROCLIMATOLOGY
Noctural topoclimatology
[WCP-117] N87-21520

MICROCRACKS
Elastic interactions of a crack with damage and associated energy release rates
[AD-A177071] N87-21385

MICROELECTRONICS
Cluster beam studies
[AD-A176803] N87-21163
Cosmic ray effects on microelectronics. Part 4
[AD-A176811] N87-21242
Transport properties of GaAs. Contribution to the study of GaAs/(Ca,Sr)F2 structures using molecular beam epitaxy
[LAAS-86-330] N87-21718

MICROPROCESSORS
The flow around a squared obstacle N87-21185
Introduction to the Z80 didactic assembly
[NOTA-INTERNA-870] N87-21595

MICROPROGRAMMING
A compiler-compiler for the SCP3 micro-program
[RSRE-MEMO-3982] N87-21592

MICROSCOPES
Research on cryogenic vacuum tunneling
[AD-A176390] N87-21662

MICROSCOPY
Research on cryogenic vacuum tunneling
[AD-A176363] N87-21082
Research on cryogenic vacuum tunneling
[AD-A176390] N87-21662

MICROSTRUCTURE
High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms
[AD-A176211] N87-21079
Microstructural response of rapidly solidified 304 stainless steel powder to three consolidation techniques
[DE87-000439] N87-21100
Processing and properties of powder metallurgy Ni(sub 3)Al-Cr-Zr-B for use in oxidizing environments
[DE87-001699] N87-21101
Design of low carbon dual-phase steels for high strength wire
[DE87-006169] N87-21104
Microstructural investigation of copolymers. A key in revealing relations between polymerization conditions and polymer properties
[ETN-87-99585] N87-21127
Ion beam sputter etching
[NASA-CASE-LEW-13899-1] N87-21160
Laser welding metallography
[DE87-004113] N87-21348

MICROWAVE ATTENUATION
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537

MICROWAVE EMISSION
Rapid changes in H alpha-flares correlated with microwaves N87-21817
Electron-cyclotron maser and solar microwave millisecond spike emission N87-21819
The generation of rapid solar flare hard X-ray and microwave fluctuations in current sheets N87-21824
A double layer model for solar X-ray and microwave pulsations N87-21829
A Japanese plan: Large radio heliograph in the solar max no. 22 N87-21831
The proposed NRAO millimeter array and its use for solar studies N87-21833

MICROWAVE FREQUENCIES
Measurement of dielectric properties of minerals at microwave frequencies, report of investigations 1986
[PB87-116968] N87-21723

MICROWAVE LANDING SYSTEMS
Developments in air traffic control systems and their relation with meteorology
[RAE-TRANS-2143] N87-20981

MICROWAVE RADIOMETERS
Remotely sensed sea surface temperature for the Alpine Experiment (ALPEX) — AVHRR-2 data N87-21497
Microwave measurements of snow in Davos (Switzerland), May-June 1986
[FOA-C-30437-3.2] N87-21525

MICROWAVE SOUNDING
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432

MICROWAVE SPECTRA
The microwave spectrum of solar millisecond spikes N87-21806
Solar microwave millisecond spike at 2.84 GHz N87-21809

MICROWAVE TRANSMISSION
Results and analysis of static and dynamic multipath in a severe atmospheric environment
[PB87-131165] N87-21231

MICROWAVES
Precision tunable resonant microwave cavity
[NASA-CASE-LEW-13935-1] N87-21234
Spectral signatures from short-pulse microwave air breakdown
[DE87-006116] N87-21686
Rapid Fluctuations in Solar Flares
[NASA-CP-2449] N87-21785
Interpretation of rapid rises in hard X-rays and microwaves with the thermal conduction front model N87-21788
Statistical analysis of fast hard X-ray bursts by SMM observations and microwave bursts by ground-based observations N87-21793
Microwave and hard X-ray emissions during the impulsive phase of solar flares: Nonthermal electron spectrum and time delay N87-21794
Position measurements of rapidly fluctuating microwave bursts N87-21800
Quasi-periodic pulsations in solar hard X-ray and microwave flares N87-21804
Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares N87-21805
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810

MIDDLE ATMOSPHERE
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422

MILITARY AIR FACILITIES
Automation strategy for a Royal Netherlands Air Force (RNLAF) air base command and control information system
[NLR-MP-85070] N87-21743

MILITARY OPERATIONS
Present and future military uses of outer space: International law, politics, and the practice of states
[AD-A176722] N87-21753

MILITARY SPACECRAFT
Accuracy of time transfer in satellite systems
[AD-A176579] N87-20984

MILITARY TECHNOLOGY
Energetic materials for military purposes: An assessment
[PB87-137220] N87-21138

MILLIMETER WAVES
Studies of millimeter-wave diffraction devices and materials. Phase 3
[AD-A176917] N87-21244
Millimeter wave generation by relativistic electron beams
[AD-A176949] N87-21245
The possible importance of synchrotron/inverse Compton losses to explain fast mm-wave and hard X-ray emission of a solar event N87-21802
Rapid spectral and flux time variations in a solar burst observed at various dm-mm wavelengths and at hard X-rays N87-21803
The proposed NRAO millimeter array and its use for solar studies N87-21833

MINERALS
Measurement of dielectric properties of minerals at microwave frequencies, report of investigations 1986
[PB87-116968] N87-21723

MIRRORS
Multifacet, metal mirror design for extreme-ultraviolet and soft X-ray free-electron laser resonators
[DE87-005100] N87-21328

MISSILE CONFIGURATIONS
Prediction of the aerodynamic characteristics of cruciform missiles including effects of roll angle and control deflection
[AD-A176553] N87-21010

MISSION PLANNING
Mars Observer: Phase 0 safety review data package
[NASA-CR-180526] N87-21019
Block 2 SRM conceptual design studies. Volume 1, Book 1: Conceptual design package
[NASA-CR-179048] N87-21034
COSPAR's contribution to the early planning of the global observing system of the Global Weather Experiment N87-21473

MIXING
Development of a large-scale antimisting kerosene blender
[AD-A176997] N87-21134
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136
Mixing-induced fluid destratification and ullage condensation N87-21149
Mixing in a double-diffusive, partially stratified fluid
[DE87-001131] N87-21285

MIXTURES
Viscosity behavior in supercooled pure liquids and mixtures
[DE87-004036] N87-21282

MODELS
The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary
[NASA-CR-178276] N87-21020
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048
Communications using channels formed by meteor bursts
[AD-A176994] N87-21222
Modeling and control of flexible structures
[AD-A177106] N87-21388
Inflation in spherically symmetric inhomogeneous models
[DE87-005405] N87-21779
Microwave and hard X-ray emissions during the impulsive phase of solar flares: Nonthermal electron spectrum and time delay N87-21794
The role of narrowband dm-spikes in solar flares N87-21801

MODES
A numerical method for solving for normal modes with impedance bottom
[AD-A176591] N87-21540

MODULATION
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft
[AD-A176815] N87-21024

MODULES
Experimental determination of the stable-trim attitudes of two proposed, general-purpose, heat-source modules
[NASA-TM-88345] N87-20967

MODULUS OF ELASTICITY
Ultrasonic cure characterization of epoxy resins: Constitutive modeling
[AD-A176661] N87-21118

MOIRE INTERFEROMETRY
Interferometric measurement of strains and displacements in engine components N87-21196
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382
MOISTURE CONTENT
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination
[ETN-87-99577] N87-21057
MOLECULAR BEAM EPITAXY
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces
[AD-A176445] N87-21691
Application of the ALE and MBE methods to the growth of layered Hg sub 1-x Cd sub x Te films
[AD-A176797] N87-21692
The 2-4 semiconductor superlattices
[AD-A177092] N87-21696
Investigations on the MBE growth and properties of Al/(y)/Ga/(y)/In/(1-x-y/As/InP) and InAlAs superlattices
[DE87-005190] N87-21709
MBE (Molecular Beam Epitaxy) growth of strained-layer superlattice device structures
[DE87-005881] N87-21711
Transport properties of GaAs. Contribution to the study of GaAs/(Ca,Sr)F2 structures using molecular beam epitaxy
[LAAS-86-330] N87-21718
MOLECULAR BEAMS
Tetrahydrogen
[AD-A176778] N87-21133
MOLECULAR CLOUDS
A CO survey of the dark nebulae in Taurus and Perseus N87-21760
MOLECULAR INTERACTIONS
Physics at the laser-atomic frontier
[PB87-126611] N87-21646
MOLECULES
Ultraviolet observations of Jupiter and Uranus N87-21762
MOLTEN SALTS
Proceedings of the International Workshop on High-Temperature Molten Salt Batteries
[DE87-003297] N87-21248
Corrosion resistant materials in MCFC environment
[DE87-004199] N87-21414
MOMENTUM TRANSFER
An overview of the long pulse experiment
[DE87-003738] N87-21326
Quasi-Lagrangian diagnostics of a Mediterranean cyclone: Isentropic results N87-21507
MONOMERS
Ordered polymers for space applications
[AD-A177108] N87-21120
MONTE CARLO METHOD
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039
Persistent time intervals between features in solar flare hard X-ray emission N87-21790
Evidence for beamed electrons in a limb X-ray flare observed by Hard X-Ray Imaging Spectrometer (HXIS) N87-21791
MORPHOLOGY
Investigations into the origins of the physical structure of thin films
[AD-A176943] N87-21117
Morphological and biochemical analysis of some rat organs and tissues following exposure to 1.1 and 2.0 G gravity N87-21569
Morphological transformations of binary images
[FOA-30447-3.3] N87-21609
MOTION SICKNESS
Effect of altered circulation on human nystagmic reactions N87-21570
Mathematical model of the otolith N87-21572
MOUNTAINS
Accuracy of temperature fields and local data sets for the Tatra mountains (Poland) N87-21492
Stratified flow and wave motion near mountain tops N87-21514
MULLITES
Development of alumina- and mullite-SiC whisker composites: High temperature properties
[DE87-004624] N87-21052
MULTIPATH TRANSMISSION
Results and analysis of static and dynamic multipath in a severe atmospheric environment
[PB87-131165] N87-21231
MULTIPHASE FLOW
Alternative flow control nozzles/energy dissipation of highly erosive fluids
[DE87-001025] N87-21273
MULTIPOLAR FIELDS
Determination of the linear aperture of the SSC (Superconducting Supercollider) clustered lattice used for the conceptual design report
[DE87-004179] N87-21698
MULTIPROCESSING (COMPUTERS)
Virtual-time operating-system functions for robotics application on a hypercube
[DE87-003656] N87-21618
MULTISENSOR APPLICATIONS
A coordinate conversion algorithm for multisensor data processing
[AD-A176366] N87-21603
MULTISPECTRAL PHOTOGRAPHY
Foundations and applications of multispectral scanning in agriculture
[NLR-MP-85015-U] N87-21408
MULTIVARIATE STATISTICAL ANALYSIS
Multivariate analyses of ALPEX satellite retrievals — Alpine Experiment (ALPEX) N87-21496
Structure theories and applications of multivariable control systems described by block canonical forms
[AD-A176482] N87-21615
Quantitative Feedback Theory (QFT): Technique for designing multivariable control systems
[AD-A176883] N87-21617
Multivariate analysis and its applications
[AD-A177019] N87-21637
MUONS
Muonic X-ray laser assisted by catalyzed fusion of deuterium and tritium
[DE87-004851] N87-21327
MUSCULAR FATIGUE
Sleep deprivation and exercise tolerance
[AD-A176171] N87-21555
Reactivity of adrenosympathetic system and tolerance to exercise load during repeated exposure to stationary magnetic field N87-21573
MUSCULAR FUNCTION
Effect of immersion hypokinesia on some parameters of human muscle potentials N87-21564
Possibility of pharmacological correction of regional osteoporosis in nonbearing extremity N87-21568
MUSCULAR TONUS
Thresholds of long-latency-period potentials and sensation of motion evoked in man by linear accelerations N87-21571
MUSCULOSKELETAL SYSTEM
Effect of immersion hypokinesia on some parameters of human muscle potentials N87-21564
Possibility of pharmacological correction of regional osteoporosis in nonbearing extremity N87-21568

N

NAP-OF-THE-EARTH NAVIGATION
Rotary-wing aircraft terrain-following/terrain-avoidance system development
[NASA-TM-88323] N87-20982
NASA PROGRAMS
University program management information system, fiscal year 1986.
[PB87-127379] N87-21736
NASA SPACE PROGRAMS
Superalloy resources: Supply and availability
[NASA-TM-89866] N87-21077
NASTRAN
Summary of the modeling and test correlations of a NASTRAN finite element vibrations model for the AH-1G helicopter, task 1
[NASA-CR-178201] N87-21373
A NASTRAN primer for the analysis of rotating flexible blades
[NASA-TM-89861] N87-21375
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378
NATIONAL SEVERE STORMS PROJECT
Verification of severe local storm forecasts issued by the National Severe Storms Forecast Center, 1985
[PB87-137139] N87-21527
NAVIER-STOKES EQUATION
Acoustic-mean flow interactions
[AD-A176845] N87-21038
Solution of the three-dimensional Navier-Stokes equations for a turbulent horseshoe vortex flow
[AD-A176370] N87-21263
Numerical simulation of compressible Navier-Stokes flow in a double throat nozzle
[AD-A177023] N87-21271
Solution of the steady state incompressible Navier-Stokes equations in curvilinear nonorthogonal coordinates
[VKI-TN-156] N87-21297
The influence of the wall boundary condition on a solution of the incompressible Navier-Stokes equation
[VKI-TM-42] N87-21298
NAVIGATION
Fault-tolerant system analysis: Imperfect switching and maintenance
[AD-A176514] N87-20995
NAVIGATION AIDS
Navigational Aid (NAVAID) vertical sounding system — atmospheric sounding N87-21479
NAVY
Hover performance of a remotely piloted helicopter
[AD-A176587] N87-20992
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136
NEBULAE
A CO survey of the dark nebulae in Taurus and Perseus N87-21760
NECK (ANATOMY)
Preliminary development, head-neck simulator. Volume 1: Analysis volunteer tests
[PB87-133245] N87-21553
Preliminary development head-neck simulator. Volume 2: Mathematical simulations
[PB87-142196] N87-21557
NEGATIVE IONS
Generation of intense negative ion beams
[NASA-CASE-NPO-16061-1-CU] N87-21660
NEODYMIUM LASERS
Graphite as a picosecond laser activated opening switch
[DE87-003758] N87-21251
Precision cutting and drilling with the Nd-YAG laser
[DE87-001359] N87-21317
A simple method for electronic feedback stabilization of an actively modelocked and Q-switched Nd:YLF laser
[DE87-002823] N87-21325
NEON
Theoretical and observational review of results on nova explosions occurring on ONeMg white dwarfs
[DE87-001962] N87-21772
NETHERLANDS
Snow depths in the Netherlands from measurements at synoptic stations in 1955 and in the period 1978-1984
[KNMI-TR-51A] N87-21522
Description of the Terschelling wind observation station for the period 1949-1980
[KNMI-TR-86] N87-21523
NETWORK ANALYSIS
Macromodeling of digital circuits
[AD-A176674] N87-21243
NEUROLOGY
European Science Notes, Volume 41, Number 2
[AD-A176116] N87-21843
NEUTRON EMISSION
Fusion technology projects
[ECN-185] N87-21689
NEUTRON SCATTERING
GANTRAS: A system of codes for the solution of the multigroup transport equation with a rigorous treatment of anisotropic neutron scattering. Plane and spherical geometry
[KFK-4163] N87-21665
NICKEL ALLOYS
High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms
[AD-A176211] N87-21079
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE87-006152] N87-21103
NICKEL HYDROGEN BATTERIES
Design and development of a multi-kilowatt hour hydrogen/nickel oxide battery
[DE87-006774] N87-21250
NIGHTGLOW
A new method of organizing spectral line intensity ratio fluctuations of auroral and nightglow emissions
[KGI-193] N87-21445
NIOBIUM ALLOYS
Electromechanical properties of superconductors for high-energy physics applications
[DE87-006048] N87-21715
NIOBIUM STANNIDES
Fusion technology projects
[ECN-185] N87-21689
NITINOL ALLOYS
Effects of stresses on the phase transformation of NITINOL
[AD-A177053] N87-21090
NITRIDING
Analysis of plasma-nitrided steels
[NASA-TM-89815] N87-21078

Ellipsometric and photoluminescent characterization of H2 and N2 multipolar plasma interactions with the 100 GaAs crystal surface
[INSA-IDI-186-05] N87-21687

NITRILES
Process for preparing phthalocyanine polymer from imide containing biaphthalonitrile
[NASA-CASE-ARC-11511-2] N87-21112

NOCTURNAL VARIATIONS
Spread F: The Scandinavian scene
[UIO-SR-86-02] N87-21443
Noctural topoclimatology
[WCP-117] N87-21520

NOISE
Nonlinearity and single shot noise problems in CARS spectroscopy N87-21174

NOISE (SOUND)
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655

NOISE GENERATORS
Some aspects of fan noise generation in axial compressors
[NLR-MP-85089-U] N87-21657

NOISE MEASUREMENT
Comparison of the effects of broad-band noise on speech intelligibility and voice quality ratings
[AD-A176900] N87-21221
Technical publication announcements covering Center programs, January to March 1986
[PB87-140273] N87-21748

NOISE PREDICTION
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023

NOISE REDUCTION
Comparator with noise suppression
[NASA-CASE-LAR-13151-1] N87-21235
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655

NONDESTRUCTIVE TESTS
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
Ultrasonic NDE of green-state ceramic using focused through-transmission
[DE87-001494] N87-21367
Nondestructive evaluation activities in the Semiconductor Materials and Processes Division
[PB87-140174] N87-21368

NONEQUILIBRIUM CONDITIONS
Study of non-equilibrium transport phenomena
[NASA-CR-180441] N87-20985

NONEQUILIBRIUM FLOW
Nonequilibrium in flowing atmospheric plasmas
[ETN-87-99587] N87-21688

NONEQUILIBRIUM PLASMAS
Nonequilibrium in flowing atmospheric plasmas
[ETN-87-99587] N87-21688

NONEQUILIBRIUM RADIATION
Study of non-equilibrium transport phenomena
[NASA-CR-180441] N87-20985

NONLINEAR EQUATIONS
NILFIT: An interactive system for nonlinear fit of data
[HMI-B431] N87-21607

NONLINEAR EVOLUTION EQUATIONS
Nonlinear evolution equations, rescalings, model Partial Differential Equations (PDE's) and their integrability, 1
[PREPRINT-524] N87-21635

NONLINEAR OPTICS
Nonlinear optics with broad-band lasers
[DE87-004306] N87-21319

NONLINEAR SYSTEMS
Nonlinear viscoelastic analysis of adhesively bonded joints
[AD-A176494] N87-21379
Stabilization and control problems in structural dynamics
[AD-A177183] N87-21389
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655

NONLINEARITY
Nonlinearity and single shot noise problems in CARS spectroscopy N87-21174

NONPARAMETRIC STATISTICS
Multivariate analysis and its applications
[AD-A177019] N87-21637

NONUNIFORM PLASMAS
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft
[AD-A176815] N87-21024

NORTHERN HEMISPHERE
Monthly and Seasonal Weather Outlook for November 1986, Volume 40, Number 21, October 30, 1986
[PB87-116960] N87-21451

NOSE CONES
A spatial marching technique for the inviscid blunt body problem
[DE87-004526] N87-20972

NOZZLE DESIGN
Filament wound data base development, revision 1, appendix A
[NASA-CR-179069] N87-21015
Numerical simulation of compressible Navier-Stokes flow in a double throat nozzle
[AD-A177023] N87-21271

NOZZLE FLOW
Numerical simulation of compressible Navier-Stokes flow in a double throat nozzle
[AD-A177023] N87-21271

NOZZLES
Alternative flow control nozzles/energy dissipation of highly erosive fluids
[DE87-001025] N87-21273

NUCLEAR ELECTRIC POWER GENERATION
School and the nuclear energy problems: Preliminary analysis of a questionnaire
[NOTA-INTERNA-873] N87-21678

NUCLEAR ENERGY
School and the nuclear energy problems: Preliminary analysis of a questionnaire
[NOTA-INTERNA-873] N87-21678

NUCLEAR FUSION
Fusion technology projects
[ECN-185] N87-21689

NUCLEAR MAGNETIC RESONANCE
A handbook of (sup)13 C NMR spectra of alkyd paint binders and associated materials — nuclear magnetic resonance (NMR)
[MQAD-TP-911] N87-21114
Development of nuclear magnetic resonance imaging techniques for characterizing green-state ceramic materials
[DE87-004987] N87-21123

NUCLEAR PHYSICS
The frontiers of physics (the next 25 years)
[DE87-004329] N87-21648

NUCLEAR REACTORS
Assessment of ceramic composites for multimegawatt space nuclear power systems
[DE87-005272] N87-21675

NUMERICAL ANALYSIS
An approach to practical aerodynamic calculations
[AD-A176995] N87-20970
On the modelling of non-reactive and reactive turbulent combustor flows
[NASA-CR-4041] N87-20996
Solution of the three-dimensional Navier-Stokes equations for a turbulent horseshoe vortex flow
[AD-A176370] N87-21283
Three dimensional numerical simulations of the UPS-292-SC engine
[DE87-001966] N87-21344
A numerical method for solving for normal modes with impedance bottom
[AD-A176591] N87-21540
Three-dimensional numerical studies of the physics of semiconductor crystal growth
[AD-A176808] N87-21693

NUMERICAL DIFFERENTIATION
Numerical boundary conditions with minimal reflection for limited-area models
[KNMI-WR-86-3] N87-21292

NUMERICAL INTEGRATION
Nonlinear evolution equations, rescalings, model Partial Differential Equations (PDE's) and their integrability, 1
[PREPRINT-524] N87-21635
Integrable 2+1 dimensional equations, their recursion operators and bi-Hamiltonian structures as reduction of multidimensional systems
[PREPRINT-540] N87-21645

NUMERICAL WEATHER FORECASTING
Four-dimensional data assimilation — numerical weather forecasting N87-21481
Assessment of results from different analysis schemes — GARP N87-21482
Weather regimes and mountain effects in general circulation models: Implications for extended range weather forecasts N87-21513
The atmospheric boundary layers
[KNMI-TR-89] N87-21524

NUTATION
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262

NUTRITION
EWAM: A model for predicting food and water ingestion, and inhalation rates of man
[DE86-900117] N87-21590

NYSTAGMUS
Effect of altered circulation on human nystagmic reactions N87-21570

O

OBSERVATION
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA21, 7-20 July 1986
[AD-A176636] N87-21541
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986
[AD-A176639] N87-21542
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986
[AD-A176795] N87-21544
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782

OCEAN BOTTOM
Tidal estimation in the Atlantic and Indian Oceans, 3 deg x 3 deg solution
[NASA-TM-87812] N87-21534
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536
Characteristics of the two-dimensional spectrum of roughness on a seamount
[AD-A176366] N87-21538
Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21548

OCEAN CURRENTS
Tidal estimation in the Atlantic and Indian Oceans, 3 deg x 3 deg solution
[NASA-TM-87812] N87-21534
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA21, 7-20 July 1986
[AD-A176636] N87-21541
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986
[AD-A176639] N87-21542
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986
[AD-A176795] N87-21544
Is the Somali Current a biological river in the Northwestern Indian Ocean
[DE87-003233] N87-21546
Chesapeake Bay circulation survey: 1981-1983
[PB87-138194] N87-21549
Technical description of an acoustic Doppler based upper ocean profiling system
[PB87-142162] N87-21551

OCEAN DATA ACQUISITIONS SYSTEMS
Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521

OCEAN MODELS
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176269] N87-21535

OCEAN SURFACE
VHF radio broadcasting: Propagation and diversity reception of mixed polarised signals over a sea path
[BBC-RD-1987/2] N87-21208
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
Technical description of an acoustic Doppler based upper ocean profiling system
[PB87-142162] N87-21551

OCEAN TEMPERATURE
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA21, 7-20 July 1986
[AD-A176638] N87-21541

Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986
[AD-A176639] N87-21542

OCEANOGRAPHIC PARAMETERS

Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535

Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA21, 7-20 July 1986
[AD-A176638] N87-21541

Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986
[AD-A176639] N87-21542

The Gulf Stream dynamics experiment: Inverted echo sounder data report for the July 1982 to April 1983 deployment period
[AD-A176776] N87-21543

Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986
[AD-A176795] N87-21544

OCEANOGRAPHY

Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521

Marine environmental assessment: Chesapeake Bay, December 1985 - February 1986
[PB87-129458] N87-21531

Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537

Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986
[AD-A176639] N87-21542

Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986
[AD-A176795] N87-21544

Directory of MIT (Massachusetts Institute of Technology) Sea Grant College Program publications, 1978-1986
[PB87-137105] N87-21550

European Science Notes, Volume 41, Number 2
[AD-A176116] N87-21843

OCEANS

Hardware design for a fixed-wing airborne gravity measurement system
[AD-A176620] N87-20993

Report to the Congress on ocean pollution, monitoring and research, October 1984 through September 1985
[PB87-129425] N87-21420

Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21546

OILS

In-flight surface oil-flow photographs with comparisons to pressure distribution and boundary-layer data
[NASA-TP-2395] N87-20966

OPERATING SYSTEMS (COMPUTERS)

Virtual-time operating-system functions for robotics application on a hypercube
[DE87-003658] N87-21618

OPERATIONS RESEARCH

Reliability growth prediction
[AD-A176128] N87-21362

OPERATORS (MATHEMATICS)

Symmetries and bi-Hamiltonian structures of 2+1 dimensional systems
[PREPRINT-536] N87-21644

Integrable 2+1 dimensional equations, their recursion operators and bi-Hamiltonian structures as reduction of multidimensional systems
[PREPRINT-540] N87-21645

OPTICAL COMMUNICATION

Synchronization tracking in pulse position modulation receiver
[NASA-CASE-NPO-16256-1] N87-21207

Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year-1
[AD-A176839] N87-21681

OPTICAL DATA STORAGE MATERIALS

Evaluation of the OSI LD1200 optical diskdrive
[NIKHEF-H/86-17] N87-21744

OPTICAL DENSITY

Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535

OPTICAL DISKS

Evaluation of the OSI LD1200 optical diskdrive
[NIKHEF-H/86-17] N87-21744

OPTICAL FILTERS

Investigation into the characteristics of ZnSe filters
[RSRE-MEMO-3993] N87-21680

OPTICAL HETERODYNING

Beam-modulation methods in quantitative and flow-visualization holographic interferometry N87-21204

OPTICAL MEASURING INSTRUMENTS

Use of laser-Doppler-anemometry for the measurement of velocity distributions at the intake of a longitudinal flow heat exchanger
[JUEL-SPEZ-362] N87-21293

OPTICAL RADAR

Haute-Provence (France) observatory lidar station, summary and outlook (1981-1986)
[ETN-87-99365] N87-21441

OPTICAL RESONATORS

Multifacet, metal mirror design for extreme-ultraviolet and soft X-ray free-electron laser resonators
[DE87-005100] N87-21328

OPTICAL SCANNERS

Optical scanner
[NASA-CASE-GSC-12897-1] N87-21679

OPTIMAL CONTROL

OPUS: Optimal Projection for Uncertain Systems
[AD-A176820] N87-21025

OPTIMIZATION

Development of optimization system OPTSYS: Implementation of static aeroelastic constraints
[FFA-TN-1986-40] N87-20994

Study of an optimum design problem with frequency criteria applied to a structure-fluid coupled system
[ECL-86-06] N87-21396

NILFIT: An interactive system for nonlinear fit of data
[HMI-B431] N87-21607

Some computational results on size reduction in H sup inf design
[OUEL-1648/86] N87-21627

Integrable 2+1 dimensional equations, their recursion operators and bi-Hamiltonian structures as reduction of multidimensional systems
[PREPRINT-540] N87-21645

Vortices in long Josephson junctions
[AD-A176916] N87-21695

OPTOELECTRONIC DEVICES

Activities report of the Department of Reconnaissance and Seeker Systems
[FOA-C-30433-3.1/3.2/3.3/3.4] N87-21227

ORBIT SPECTRUM UTILIZATION

The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 1: Executive summary
[NASA-CR-179597-VOL-1] N87-21212

The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 2: Technical report
[NASA-CR-179597-VOL-2] N87-21213

ORBIT TRANSFER VEHICLES

Orbital transfer vehicle concept definition and system analysis study. Volume 1A: Executive summary. Phase 2
[NASA-CR-179055] N87-21018

ORBITAL SPACE STATIONS

The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary
[NASA-CR-178276] N87-21020

ORDER-DISORDER TRANSFORMATIONS

Ordered polymers for space applications
[AD-A177108] N87-21120

ORGANIC COMPOUNDS

Supercritical fluid chromatography of polar organic compounds in combustion particulates
[PB87-126645] N87-21073

Gravimetric technique for the preparation of accurate trace organic gas standards
[PB87-145736] N87-21074

Basic ideas in the theory of organic conductors
[DE87-003209] N87-21699

ORGANIC MATERIALS

Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535

ORGANOMETALLIC COMPOUNDS

Method for forming hermetic seals
[NASA-CASE-NPO-16423-1-CU] N87-21334

ORIFICES

Liquid seeding atomizer
[NASA-CASE-ARC-11631-1] N87-21255

ORIGINS

Origin of cracking phenomena observed in decomposition reactions
[DE87-000199] N87-21392

OROGRAPHY

The determination of lee circulation during the Foehn wind N87-21485

Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1
[WMO-TD-VOL-1] N87-21485

The aim and conduct of ALPEX — Alpine Experiment (ALPEX) N87-21486

Accuracy of temperature fields and local data sets for the Tatra mountains (Poland) N87-21492

A theory of deep cyclogenesis in the lee of the Alps: Modification of baroclinic instability by topography N87-21499

The mechanisms of orographic cyclogenesis N87-21500

Spanish Limited Area Model (LAM) behavior in two cases of Mediterranean cyclogenesis N87-21502

Representation of pressure drag effects in numerical modeling of Alpine cyclogenesis N87-21503

Numerical simulation of lee cyclogenesis during Alpine Experiment with an isentropic coordinate model N87-21504

The role of Alps mountains representation in the lee cyclogenesis simulation N87-21505

On the synoptics and dynamics of orographically induced cyclones in the Mediterranean N87-21506

Weather regimes and mountain effects in general circulation models: Implications for extended range weather forecasts N87-21513

Stratified flow and wave motion near mountain tops N87-21514

ORTHOSTATIC TOLERANCE

Bioelectrical activity of the heart and blood electrolytes in essentially healthy subjects submitted to antiorthostatic hypokinesia for 120 days N87-21563

Change in bile acid and lipid content of human bile during exposure to antiorthostatic hypokinesia and its correction N87-21565

OSCILLATING FLOW

An approach to practical aerodynamic calculations
[AD-A176995] N87-20970

Stability of the vortex motion in oscillating flow
[AD-A176629] N87-21267

Heat transfer in oscillatory flow
[DE87-004374] N87-21278

OSCILLATIONS

Rapid Fluctuations in Solar Flares
[NASA-CP-2449] N87-21785

The role of narrowband dm-spikes in solar flares N87-21801

Temporal frequency of radio emissions for the April 25, 1984 flare N87-21808

OSCILLATORS

Low phase noise oscillator using two parallel connected amplifiers
[NASA-CASE-GSC-13018-1] N87-21232

OSTEOPOROSIS

Quantitative study of osteoblasts and osteoclasts of rat bones with simulation of weightlessness N87-21566

Possibility of pharmacological correction of regional osteoporosis in nonbearing extremity N87-21568

OTOLITH ORGANS

Mathematical model of the otolith N87-21572

OUTPUT

Tabulated output from ELLA — hardware design and description language (ELLA)
[RSRE-MEMO-3966] N87-21602

OXIDATION

High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms
[AD-A176211] N87-21079

Oxidation behavior of chromium and a chromium-yttrium binary alloy
[DE87-003772] N87-21095

Vectorial electron transfer on designed surfaces
[PB87-144325] N87-21137

OXIDATION-REDUCTION REACTIONS

Advanced B and Al combustion kinetics studies over wide temperature ranges
[AD-A176828] N87-21061

OXYGEN
Data from the Optical Dynamics Experiment (ODEX) R/V scania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535
OXYGEN ATOMS
Variable energy, high flux, ground-state atomic oxygen source
[NASA-CASE-NPO-16640-1-CU] N87-21661
OXYGEN BREATHING
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness
[AD-A176558] N87-21556
OXYGEN SPECTRA
Comparison of solar hard X-ray and UV line and continuum bursts with high time resolution N87-21813
OV and hard X-rays, observations and model calculations N87-21814
OZONE
Retrievals of lower stratospheric ozone profiles from Nimbus-4 and their use in a synoptic-climatological study N87-21423
Operations handbook-ozone measurements to 40-km altitude with Model 4A Electrochemical Concentration Cell (ECC) ozonesonses (used with 1680-MHz radiosondes)
[PB87-113874] N87-21426
Three dimensional dynamical and chemical modelling of the upper atmosphere
[NASA-CR-180514] N87-21428
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere
[DE87-003600] N87-21438

P

PACIFIC OCEAN
Mariners weather log, volume 30, number 4, Fall 1986
[PB87-129417] N87-21526
PACKET TRANSMISSION
Communications using channels formed by meteor bursts
[AD-A176994] N87-21222
PACKETS (COMMUNICATION)
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
PAINTS
A handbook of (sup)13 C NMR spectra of alkyd paint binders and associated materials — nuclear magnetic resonance (NMR)
[MOAD-TP-911] N87-21114
PARALLEL PROCESSING (COMPUTERS)
Algorithm implementation on the Navier-Stokes computer
[NASA-TM-89119] N87-20968
Hypercube Applications at Oak Ridge National Laboratory
[DE87-005891] N87-21594
Exploiting loop level parallelism in nonprocedural dataflow programs
[NASA-CR-178277] N87-21613
PARAMETER IDENTIFICATION
Effective removal parameters in long-range transport models, derived from diffusion theory calculations — air pollution
[ECN-187] N87-21419
Influencing variables in the assessment of vertical wind velocity by means of flight-mechanics equations N87-21457
The estimation of parameters in functional relationship models
[ETN-87-99586] N87-21630
PARAMETERIZATION
Automatic shape parameterisation in machine vision
[NPL-DITC-79/86] N87-21597
NILFIT: An interactive system for nonlinear fit of data
[HMI-B431] N87-21607
Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems
[PREPRINT-542] N87-21674
PARTIAL DIFFERENTIAL EQUATIONS
Computer-aided analysis of two-dimensional laminar and turbulent incompressible flows N87-21256
Nonlinear evolution equations, rescalings, model Partial Differential Equations (PDE's) and their integrability, 1
[PREPRINT-524] N87-21635
PARTICLE ACCELERATION
Fast fluctuations of soft X-rays from active regions N87-21797
PARTICLE ACCELERATORS
A 1-ms electron beam facility for laser kinetic studies
[DE87-003299] N87-21323
PARTICLE COLLISIONS
Light gluinos and fixed target experiments
[PREPRINT-526] N87-21668
Searching for an intermediate mass Higgs boson at large energy e+e-, linear colliders
[PREPRINT-530] N87-21671
Heavy Higgs production at future colliders
[PREPRINT-531] N87-21672
Theoretical summary — p pbar
[PREPRINT-532] N87-21730
PARTICLE DIFFUSION
Implementation of three speckle reduction filters for solid propellant combustion holograms
[AD-A176583] N87-21132
PARTICLE MOTION
On the upper critical dimension in Anderson localization
[PREPRINT-514] N87-21638
PARTICLE PRODUCTION
Joint production of phi mesons and pi(+,-), pi(0), rho, rho bar, K(0)S and K(+,-) in hadronic interactions
[NIKHEF-H/86-2] N87-21663
The production of weak intermediate bosons in electron-positron reactions
[PREPRINT-520] N87-21667
Light gluinos and fixed target experiments
[PREPRINT-526] N87-21668
Searching for an intermediate mass Higgs boson at large energy e+e-, linear colliders
[PREPRINT-530] N87-21671
Heavy Higgs production at future colliders
[PREPRINT-531] N87-21672
PARTICLE SIZE DISTRIBUTION
Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21546
PARTICLES
Techniques to determine particulates in liquid fuels
[DE87-002028] N87-21135
Laser-2 focus velocimetry N87-21177
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
PARTICULATES
Techniques to determine particulates in liquid fuels
[DE87-002028] N87-21135
PASSENGER AIRCRAFT
Aircraft accident reports: Brief format, US civil and foreign aviation, issue number 14, 1985 accidents
[PB86-916926] N87-20980
PASSENGERS
Extended Range Twin Operations (ETOPS) — twin engined aircraft
[CAP-513] N87-20976
PASSIVITY
Ellipsometric and photoluminescent characterization of H2 and N2 multipolar plasma interactions with the 100 GaAs crystal surface
[INSA-IDI-186-05] N87-21687
PATHOGENESIS
Effect of spaceflight factors on hemopoiesis N87-21560
PATTERN RECOGNITION
Three-dimensional sensing and interpretation
[AD-A176906] N87-21340
PELVIS
Some pathological signs in pelvis minor organs after exposure to long-term high-level +Gz accelerations N87-21577
PENALTY FUNCTION
Penalization study of a variational inequalities system used to model a cylindrical shell with symmetric loading
[ECL-86-08] N87-21397
PENETRATION
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217
PERFORMANCE PREDICTION
Challenges in modeling the X-29 flight test performance
[NASA-TM-88282] N87-20991
A new design concept for indraft wind-tunnel inlets with application to the national full-scale aerodynamic complex
[NASA-TM-88226] N87-21006
A simplified appraisal of the pulsed performance of electrothermal hydrazine thrusters
[RAE-TM-SPACE-355] N87-21033
A modeling and simulation tool for fault-tolerant distributed systems applied to distributed database management systems
[KFK-4138] N87-21614
PERFORMANCE TESTS
Filament wound data base development, revision 1, appendix B
[NASA-CR-179070] N87-21017
Performance test of 110 mm bore ball bearing made from corrosion resistant powdered steel
[AD-A177060] N87-21342
Manipulator Comparative Testing Program
[DE87-006026] N87-21355
An agenda for improved evaluation of supercomputer performance
[DE87-005698] N87-21593
Agenda for improved evaluation of supercomputer performance
[PB87-137196] N87-21596
Evaluation of the OSI LD1200 optical disk drive
[NIKHEF-H/86-17] N87-21744
PERIODIC VARIATIONS
On the 152-day periodicity of the solar flare occurrence rate
[NASA-CR-180519] N87-21638
PERSONNEL
Theoretical development for identifying underlying internal processes. Volume 1. The theory of underlying internal processes
[AD-A176466] N87-21586
PHARMACOLOGY
Individual distinctions of fluid-electrolyte metabolism during hypokinesia with head-down tilt for 120 days and efficacy of preventive agents N87-21582
Possibility of pharmacological correction of regional osteoporosis in nonbearing extremity N87-21586
PHASE CHANGE MATERIALS
Picosecond laser pulse interactions with metallic and semiconductor surfaces
[AD-A176845] N87-21087
PHASE LOCKED SYSTEMS
Compressor blade clearance measurement using capacitance and phase lock techniques N87-21200
PHASE MODULATION
Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year-1
[AD-A176839] N87-21681
PHASE SHIFT
Performance of two coupled lasers
[AD-A177185] N87-21312
PHASE SHIFT CIRCUITS
Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year -1
[AD-A176839] N87-21681
PHASE TRANSFORMATIONS
Effects of stresses on the phase transformation of NITINOL
[AD-A177053] N87-21090
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Ten degree Kelvin hydride refrigerator
[NASA-CASE-NPO-16393-1-CU] N87-21159
Phase selection during pulsed laser annealing of Fe-V alloys
[DE87-003507] N87-21318
Superlattice effects in graphite intercalation compounds
[AD-A176879] N87-21684
PHASED ARRAYS
Phase pattern of phased array element
[AD-A176821] N87-21218
Saturation effects in coupled lasers with homogeneous gain
[AD-A176843] N87-21314
PHENOMENOLOGY
Hadron phenomenology via the fire-string model
[PREPRINT-533] N87-21731
PHONEMES
Multispeaker number recognition
[ENST-86E008] N87-21225
PHOSPHORIC ACID
Ordered polymers for space applications
[AD-A177108] N87-21120
PHOSPHORUS POLYMERS
Ordered polymers for space applications
[AD-A177108] N87-21120
PHOTOCONDUCTORS
Graphite as a picosecond laser activated opening switch
[DE87-003758] N87-21251
GaAs photoconductors to characterize picosecond response in GaAs integrated devices and circuits
[DE87-003744] N87-21704
Characterization of on-chip polycrystalline silicon photoconductors
[DE87-003745] N87-21705
PHOTODIODES
Some considerations relating to aero engine pyrometry N87-21187

PHOTOELECTRIC EMISSION
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft
[AD-A176815] N87-21024
Average configuration of the quiet auroral oval
[DMI-GEOPHYS-PAPERS-R-73] N87-21446
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces
[AD-A176445] N87-21691
PHOTOGRAPHIC PROCESSING EQUIPMENT
Automatic processing system for shadowgraph and interference patterns
[NASA-TM-86525] N87-21307
PHOTOGRAPHY
In-flight surface oil-flow photographs with comparisons to pressure distribution and boundary-layer data
[NASA-TP-2395] N87-20966
Rapid search for spherical objects in aerial photographs
[AD-A176391] N87-21406
PHOTOIONIZATION
Fast temporal correlation between hard X-ray and ultraviolet continuum brightenings N87-21612
PHOTOLUMINESCENCE
Investigations on the MBE growth and properties of Al/(y)/Ga/(y)/In/(1-x-y//As/InP) and InAlAs superlattices
[DE87-005190] N87-21709
PHOTONS
A third class of high energy burster
[DE87-006051] N87-21841
PHOTONUCLEAR REACTIONS
The hydrogen coverage of interstellar PAHs
[NASA-TM-89340] N87-21780
PHOTOVOLTAIC CELLS
Pulsed excimer laser processing for cost-effective solar cells
[NASA-CR-180528] N87-21413
PHTHALOCYANIN
Process for preparing phthalocyanine polymer from imide containing biphthalonitrile
[NASA-CASE-ARC-11511-2] N87-21112
PHYSICAL EXERCISE
Reactivity of adrenosympathetic system and tolerance to exercise load during repeated exposure to stationary magnetic field N87-21573
PHYSIOLOGICAL RESPONSES
Evaluation of functional state of pilots on the basis of interhemispheric asymmetry N87-21561
Morphological and biochemical analysis of some rat organs and tissues following exposure to 1.1 and 2.0 G gravity N87-21569
Thresholds of long-latency-period potentials and sensation of motion evoked in man by linear accelerations N87-21571
PHYSIOLOGY
Neurohumoral and mechanical factors in the modulation of left ventricular mass
[NASA-CR-180524] N87-21554
Inception of Soviet system of medical screening of cosmonauts (hospital stage) N87-21559
PICOSECOND PULSES
Picosecond laser pulse interactions with metallic and semiconductor surfaces
[AD-A176645] N87-21087
Analysis of picosecond pulsed laser melted graphite
[DE87-003755] N87-21124
PIEZOELECTRIC CERAMICS
Lead titanates: Electromechanical anisotropic materials applicable to electroacoustic instrumentation
[INSA-IDI1-8603] N87-21068
PIGMENTS
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535
PILOT PERFORMANCE
Evaluation of functional state of pilots on the basis of interhemispheric asymmetry N87-21561
Human factors research in aircrew performance and training
[AD-A176099] N87-21586
PILOT SELECTION
Inception of Soviet system of medical screening of cosmonauts (hospital stage) N87-21559
PILOT TRAINING
Objective testing for the pilot's instrument rating. Specimen examination material: Flight planning and navigation procedures, flight instruments and radio aids, meteorology, aviation law, flight rules and procedures
[CAP-519] N87-21583
Human factors research in aircrew performance and training
[AD-A176099] N87-21586
PINS
Wave propagation in periodic truss structures
[AD-A176548] N87-21381
PIPES (TUBES)
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
Liquid seeding atomizer
[NASA-CASE-ARC-11631-1] N87-21255
PITTING
Inhibition of localized corrosion
[AD-A176573] N87-21083
PLANE WAVES
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217
PLANETARY BOUNDARY LAYER
Tethered balloon measurements made at Naval Air Development Center (December 1985)
[AD-A176254] N87-21517
PLANETARY NEBULAE
On the mass loss rate by the nuclei of planetary nebulae
[DE87-701325] N87-21777
PLANETOLOGY
Research in planetary studies and operation of the Mauna Kea Observatory
[NASA-CR-180513] N87-21763
PLANKTON
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535
Biological processes in the water column of the south Atlantic bight: Phytoplankton responses
[DE87-003987] N87-21547
PLANNING
The application of Computer Aided Design (CAD) techniques in a route-planning system
[NLR-MP-85039-U] N87-21605
PLASMA ARC WELDING
Plasma joining of metal matrix composites
[AD-A176690] N87-21042
PLASMA CLOUDS
Theoretical investigations of releases of lithium in the Earth's magnetosphere
[AD-A177080] N87-21437
PLASMA CURRENTS
Solar wind plasma in the magnetosphere method of entry and consequences
[AD-A177255] N87-21835
PLASMA INTERACTIONS
Ellipsometric and photoluminescent characterization of H2 and N2 multipolar plasma interactions with the 100 GaAs crystal surface
[INSA-IDI-186-05] N87-21687
Solar wind plasma in the magnetosphere method of entry and consequences
[AD-A177255] N87-21835
PLASMA PHYSICS
Rapid Fluctuations in Solar Flares
[NASA-CP-2449] N87-21785
PLASMA TURBULENCE
Plasma turbulence and impulsive UV line emission in solar flares N87-21818
The propagation of solar flare particles in a coronal loop N87-21826
PLASMA WAVES
A study of the propagation of ULF electromagnetic fields in collisional, inhomogeneous, magnetized plasmas
[DE87-004768] N87-21223
Theoretical studies on rapid fluctuations in solar flares N87-21830
PLASMAS (PHYSICS)
The magnetic flux contributed by the plasma armature in an electromagnetic launcher
[MRL-R-1033] N87-21009
Laser evaporation studies
[AD-A176826] N87-21313
A self-similar approach to the explosion of droplets by a high energy laser beam
[DE87-005124] N87-21322
Development of techniques for the use of DMSP (Defense Meteorology Satellite Program) SSIE (Topside Ionospheric Plasma Monitor) data in the AWS (Air Weather Service) 4D ionosphere model
[AD-A176412] N87-21430
Plasma physics abstracts, 1 January - 31 December, 1986
[NASA-CR-180220] N87-21684
The interchange instability in high-latitude plasma blobs
[AD-A176242] N87-21685
Solar VLBI N87-21807
PLASMASPHERE
Theoretical investigations of releases of lithium in the Earth's magnetosphere
[AD-A177080] N87-21437
PLASTIC DEFORMATION
Fundamentals of hardening and decohesion behavior in time-dependent cycle deformation
[DE87-003995] N87-21091
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382
PLASTIC PROPERTIES
Localized plasticity of graphite/magnesium metal matrix composites
[DE87-004542] N87-21053
Strain and stress cycling in elastic-plastic materials N87-21372
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384
PLATINUM
Vectorial electron transfer on designed surfaces
[PB87-144325] N87-21137
PLOTTING
The Gulf Stream dynamics experiment: Inverted echo sounder data report for the July 1982 to April 1983 deployment period
[AD-A176776] N87-21543
PLUMES
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519
POINT IMPACT
Calculation of the effect of a point impact on an infinite elastic plate adjacent to a semi-infinite fluid
[NPL-DITC-60/86] N87-21369
POINT SOURCES
Acoustic emission point source locations on thin spherical shell
[DE87-004015] N87-21393
POLAR ORBITS
Progress toward predicting high-voltage charging of spacecraft in low polar orbit
[AD-A176939] N87-21027
Retrieval of moving waves from polar orbiting satellite data N87-21404
POLAR REGIONS
The interchange instability in high-latitude plasma blobs
[AD-A176242] N87-21685
POLARIMETRY
Impulsive phase solar flare X-ray polarimetry N87-21789
POLARIZATION (WAVES)
Raman spectra of water in the translational and librational regions. Part 1: Study of the depolarization ratio
[PREPRINT-534] N87-21071
VHF radio broadcasting: Propagation and diversity reception of mixed polarised signals over a sea path
[BBC-RD-1987/2] N87-21208
POLLUTION MONITORING
Report to the Congress on ocean pollution, monitoring and research, October 1984 through September 1985
[PB87-129425] N87-21420
POLLUTION TRANSPORT
Atmospheric transport and dispersion of pollutants and related meteorological studies: Program summary
[DE87-005644] N87-21418
Effective removal parameters in long-range transport models, derived from diffusion theory calculations — air pollution
[ECN-187] N87-21419
POLYCRYSTALS
Quasi-containerless glass formation method and apparatus
[NASA-CASE-MFS-28090-1] N87-21111
Characterization of on-chip polycrystalline silicon photoconductors
[DE87-003745] N87-21705
POLYESTERS
Comparison of the toxicity of the combustion products from a flexible polyurethane foam and a polyester fabric evaluated separately and together by the NBS (National Bureau of Standards) toxicity test method and a cone radiant heater toxicity test apparatus
[PB87-140265] N87-21169

POLYMER MATRIX COMPOSITES
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: An initial study
[NASA-TM-89846] N87-21043
POLYMERIZATION
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: An initial study
[NASA-TM-89846] N87-21043
Prediction of fire properties of materials. Part 1: Aliphatic and aromatic hydrocarbons and related polymers
[PB87-140240] N87-21072
Process for preparing phthalocyanine polymer from imide containing bisphthalonitrile
[NASA-CASE-ARC-11511-2] N87-21112
Network polymers formed under nonideal conditions
[AD-A176408] N87-21115
Ordered polymers for space applications
[AD-A177108] N87-21120
POLYURETHANE FOAM
Comparison of the toxicity of the combustion products from a flexible polyurethane foam and a polyester fabric evaluated separately and together by the NBS (National Bureau of Standards) toxicity test method and a cone radiant heater toxicity test apparatus
[PB87-140265] N87-21169
POROUS MATERIALS
Modeling the convection-radiation coupling in porous materials and identification of their radiation characteristics: Application to glass wools
[INSA-86-ISAL-0007] N87-21290
Electrokinetic and hydrodynamic transport through porous media
[ETN-87-99581] N87-21299
PORTABLE EQUIPMENT
Acoustic guide for noise-transmission testing of aircraft
[NASA-CASE-LAR-13111-1-CU] N87-21652
POSITION (LOCATION)
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985
Stability of the vortex motion in oscillating flow
[AD-A176629] N87-21267
The near-minimum time control of a robot arm
[AD-A176875] N87-21339
Acoustic emission point source locations on thin spherical shell
[DE87-004015] N87-21393
On the upper critical dimension in Anderson localization
[PREPRINT-514] N87-21638
POSITION INDICATORS
Canadian Coast Guard 406 MHz EPIRB (Emergency Position Indicating Radiobeacon) experimental results
[AD-A176430] N87-20978
Synchronization tracking in pulse position modulation receiver
[NASA-CASE-NPO-16256-1] N87-21207
POSITIONING
Low noise lead screw positioner
[NASA-CASE-NPO-15617-1] N87-21304
POSITRONS
The production of weak intermediate bosons in electron-positron reactions
[PREPRINT-520] N87-21667
POTASSIUM HYDRIDES
Preparation and characterization of potassium hydroaluminates KAlH4, K3AlH6, K2NaAlH6, K3AlH4F2
[INSA-IDTC1-8602] N87-21057
POTENTIAL THEORY
Ellipsoidal corrections to potential coefficients obtained from gravity anomaly data on the ellipsoid
[AD-A176901] N87-21435
POWDER METALLURGY
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
Mechanical properties of elementally blended Ti-6Al-4V
[AD-A176640] N87-21086
Processing and properties of powder metallurgy Ni(sub 3)Al-Cr-Zr-B for use in oxidizing environments
[DE87-001699] N87-21101
POWDERED ALUMINUM
Mechanical properties of elementally blended Ti-6Al-4V
[AD-A176640] N87-21086
POWER SPECTRA
Calculation of power-flux density levels in the 2 GHz band, phase three
[PB87-120523] N87-21230
Characteristics of the two-dimensional spectrum of roughness on a seamount
[AD-A176366] N87-21538
PRECIPITATION (METEOROLOGY)
Monthly and Seasonal Weather Outlook for November 1986, Volume 40, Number 21, October 30, 1986
[PB87-118660] N87-21451
PRECIPITATION HARDENING
Fundamentals of hardening and decohesion behavior in time-dependent cycle deformation
[DE87-003995] N87-21091
PRECISION
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California
[AD-A176509] N87-20958
Application of a high-precision universal measuring machine in Standards Laboratory measurements
[DE87-003036] N87-21308
Precision cutting and drilling with the Nd-YAG laser
[DE87-001359] N87-21317
Journal of Research of the National Bureau of Standards, Volume 91, Number 4, July-August 1986
[PB87-109864] N87-21649
PREDICTION ANALYSIS TECHNIQUES
Resistance curve approach to predicting residual strength of composites
[AD-A176984] N87-21050
Computational model for the simulation of millimeter-wave propagation through the clear atmosphere
[PB87-131173] N87-21209
PREDICTIONS
State equation of condensed materials: Physical principles and applications
[ECL-86-15] N87-21069
Prediction of fire properties of materials. Part 1: Aliphatic and aromatic hydrocarbons and related polymers
[PB87-140240] N87-21072
Improvement of fatigue life prediction accuracy for various realistic loading spectra by use of correction factors
[TAE-581] N87-21374
PREIMPREGNATION
Preimpregnated T5A-145-12-F584 carbon/epoxy from Hexcel-Genin: Elementary characterization
[PV-M5-517700] N87-21126
PRELAUNCH TESTS
Testing of the advanced microwave instrument for the European Remote Sensing Satellite ERS-1
[ETN-87-99477] N87-21409
PREMIXED FLAMES
On the aerodynamics of flames N87-21056
Turbulent premixed flame study
[DE87-006255] N87-21066
Simultaneous temperature measurements with Raman and CARS in laminar flames N87-21171
Application of CARS thermometry to a turbulent flame N87-21175
PREPARATION
Document preparation guide
[DE86-015942] N87-21738
PRESSURE BREATHING
Centrifuge testing of a G compensated/pressure demand oxygen regulator
[AD-A176117] N87-21587
PRESSURE DISTRIBUTION
In-flight surface oil-flow photographs with comparisons to pressure distribution and boundary-layer data
[NASA-TP-2395] N87-20966
The variation of pressure on the ground with height of burst of high explosive charges
[AWRE-O-9/86] N87-21258
Wavevector-frequency spectrum of transition zone wall pressure fluctuations
[AD-A176655] N87-21268
PRESSURE GAGES
Amplitude-independent fiber-optic pressure sensor
[DE87-003873] N87-21682
PRESSURE GRADIENTS
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264
PRESSURE MEASUREMENT
Acquisition and processing of non-stationary pressure measurments in studies of air intake distortion N87-21191
The variation of pressure on the ground with height of burst of high explosive charges
[AWRE-O-9/86] N87-21258
PRESSURE REDUCTION
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness
[AD-A176558] N87-21556
PRESSURE SENSORS
The utilization of thin film sensors for measurements in turbomachinery N87-21195
Amplitude-independent fiber-optic pressure sensor
[DE87-003873] N87-21682
PRESSURE SUITS
Centrifuge testing of a G compensated/pressure demand oxygen regulator
[AD-A176117] N87-21587
PRIMERS (COATINGS)
The corrosion mechanisms for primer coated 2219-T87 aluminum
[NASA-TP-2715] N87-21076
PRIMITIVE EARTH ATMOSPHERE
Ultraviolet observations of Jupiter and Uranus N87-21762
PRINTED CIRCUITS
Development of the diffusion bonding process
[DE87-006598] N87-21164
Measurement of fatigue crack growth kinetics of Copper-Kapton laminates by dynamic mechanical thermal analysis
[DE87-003024] N87-21390
PROBABILITY DENSITY FUNCTIONS
Application of CARS thermometry to a turbulent flame N87-21175
PROBES
Precision tunable resonant microwave cavity
[NASA-CASE-LEW-13935-1] N87-21234
PROCEDURES
Contribution to the implementation of dynamic vision in the three-dimensional perception system of the HILARE robot
[CNRS-ORDER-959] N87-21357
PROCESS CONTROL (INDUSTRY)
Task execution control in assembly robot workcells
[LAAS-86-335] N87-21356
PRODUCT DEVELOPMENT
Introduction to the development of automation plans for Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) in mechanical engineering
[NLR-MP-85042-U] N87-21606
Providing knowledge by means of artificial intelligence techniques: Experiences and developments at the National Aerospace Laboratory (NLR)
[NLR-MP-85081-U] N87-21622
PRODUCTION ENGINEERING
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Rapid isothermal processing systems: An overview
[RSRE-MEMO-3967] N87-21238
Vortices in long Josephson junctions
[AD-A176916] N87-21695
PRODUCTIVITY
Is the Somali Current a biological river in the Northwestern Indian Ocean
[DE87-003233] N87-21548
PROFILOMETERS
Inspection of complex profiles: A review of the methods available, and best suited to the needs of RAE Pyestock
[RAE-TM-P-1077] N87-21306
PROGRAMMERS
The Universal Transverse Mercator grid formulas for cartographic applications programmers
[AD-A176624] N87-21407
PROGRAMMING LANGUAGES
Towards an object oriented satellite test environment
[ETN-87-99476] N87-21031
PROJECT MANAGEMENT
Space experiment development process N87-21156
Proceedings of the International Conference on the Results of the Global Weather Experiment and Their Implications for the World Weather Watch, Volume 1
[WMO-TD-107-VOL-1] N87-21470
The objectives of the Global Weather Experiment and overall view of the accomplishment of GARP N87-21471
The aim and conduct of ALPEX — Alpine Experiment (ALPEX) N87-21486
PROJECTILES
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262
PRONY SERIES
Original improvements of the TLM method
[RAE-TRANS-2151] N87-21624
PROP-FAN TECHNOLOGY
Summary of studies to reduce wing-mounted propfan installation drag on an M = 0.8 transport
[NASA-TP-2678] N87-20990

PROPAGATION MODES
Irregular modes in a duct with an impedance wall
[NLR-MP-85066-U] N87-21656
PROPELLANT GRAINS
Implementation of three speckle reduction filters for solid propellant combustion holograms
[AD-A176583] N87-21132
PROPELLANT TRANSFER
Overview: Fluid acquisition and transfer N87-21146
PROPELLER BLADES
La Recherche Aerospatiale, bimonthly bulletin, number 1986-2, 231/March-April
[ESA-TT-998] N87-20974
PROPULSION
Activities report in energy science — propulsion systems
[ETN-87-99373] N87-21165
Digital image processing applied to fluid dynamic problems N87-21193
PROPULSION SYSTEM CONFIGURATIONS
Activities report in energy science — propulsion systems
[ETN-87-99373] N87-21165
PROPULSION SYSTEM PERFORMANCE
Activities report in energy science — propulsion systems
[ETN-87-99373] N87-21165
PROPULSIVE EFFICIENCY
Activities report in energy science — propulsion systems
[ETN-87-99373] N87-21165
PROTECTIVE COATINGS
The corrosion mechanisms for primer coated 2219-T87 aluminum
[NASA-TP-2715] N87-21078
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys
[AD-A176970] N87-21089
PROTEIN SYNTHESIS
Rat brain polyamine levels during long-term hypokinesia N87-21580
PROTOCOL (COMPUTERS)
Communications using channels formed by meteor bursts
[AD-A176994] N87-21222
A modeling and simulation tool for fault-tolerant distributed systems applied to distributed database management systems
[KFK-4136] N87-21614
PROTON BEAMS
SC correction coils and magnets for the HERA proton ring
[NIKHEF-H/86-10] N87-21676
PROTONS
The hydrogen coverage of interstellar PAHs
[NASA-TM-89340] N87-21780
PROTOTYPES
Aluminum-air battery crystallizer
[DE87-005839] N87-21252
PROTUBERANCES
A correlation for the heat transfer coefficient in a rectangular passage containing protuberance
[AD-A176111] N87-21261
PROVING
Validation of SAM 2 and SAGE satellite
[NASA-CR-178256] N87-21429
PSYCHOPHYSIOLOGY
Group dynamics and performance efficiency under extreme conditions N87-21578
PULLING
Fiber glass pulling — in space
[NASA-CR-179036] N87-21140
Dual motion valve with single motion input
[NASA-CASE-MFS-28058-1] N87-21332
PULMONARY CIRCULATION
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness
[AD-A176558] N87-21556
PULSE COMMUNICATION
The fundamentals of timing and synchronization for digital communication networks
[AD-A176721] N87-21220
PULSE GENERATORS
Synchronization tracking in pulse position modulation receiver
[NASA-CASE-NPO-16256-1] N87-21207
GaAs photoconductors to characterize picosecond response in GaAs integrated devices and circuits
[DE87-003744] N87-21704
PULSE MODULATION
Synchronization tracking in pulse position modulation receiver
[NASA-CASE-NPO-16256-1] N87-21207
PULSE RADAR
A quick look at the first NRL short pulse 95 GHz radar flight data
[AD-A176182] N87-21214
PULSED JET ENGINES
A simplified appraisal of the pulsed performance of electrothermal hydrazine thrusters
[RAE-TM-SPACE-355] N87-21033
Flow induction by rotary jets
[AD-A177013] N87-21270
PULSED LASERS
Picosecond laser pulse interactions with metallic and semiconductor surfaces
[AD-A176845] N87-21087
Analysis of picosecond pulsed laser melted graphite
[DE87-003755] N87-21124
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
Laser evaporation studies
[AD-A176826] N87-21313
Experimental and theoretical studies of laser propulsion phenomenology
[AD-A176851] N87-21315
Short wavelength laser/materials interactions
[AD-A176950] N87-21316
Phase selection during pulsed laser annealing of Fe-V alloys
[DE87-003507] N87-21318
Nonlinear optics with broad-band lasers
[DE87-004306] N87-21319
Layered target burnthrough experiments using 50 nsec KrF laser pulses
[DE87-005111] N87-21329
Pulsed excimer laser processing for cost-effective solar cells
[NASA-CR-180526] N87-21413
PULSED RADIATION
Acoustic radiation stress measurement
[NASA-CASE-LAR-13440-1] N87-21653
PULSES
Investigation of the characteristics of liquid fuel burning, Rijke type, pulsating combustors
[DE87-001931] N87-21063
An overview of the long pulse experiment
[DE87-003738] N87-21326
PULTRUSION
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
PURITY
Quasi-containerless glass formation method and apparatus
[NASA-CASE-MFS-28090-1] N87-21111
PUSHING
Dual motion valve with single motion input
[NASA-CASE-MFS-28058-1] N87-21332
PYRENEES MOUNTAINS (EUROPE)
Laboratory simulation of rotating stratified flow over and around the Alps N87-21516
PYROELECTRICITY
European Science Notes, Volume 41, Number 2
[AD-A176116] N87-21843
PYROLYTIC GRAPHITE
Investigations into the origins of the physical structure of thin films
[AD-A176943] N87-21117
PYROMETERS
Sapphire fiber optic temperature probe N87-21186
Turbine rotor blade measurements using infrared pyrometry N87-21188
PYROTECHNICS
Energetic materials for military purposes: An assessment
[PB87-137220] N87-21138

Q

QUALIFICATIONS
Objective testing for the pilot's instrument rating. Specimen examination material: Flight planning and navigation procedures, flight instruments and radio aids, meteorology, aviation law, flight rules and procedures
[CAP-519] N87-21583
QUALITY
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136
Comparison of the effects of broad-band noise on speech intelligibility and voice quality ratings
[AD-A176900] N87-21221
QUALITY CONTROL
Block 2 SRM conceptual design studies. Volume 1, Book 1: Appendix A: CEI specification CPW1-1900, Appendix B: Composite motor case
[NASA-CR-179049] N87-21035
Block 2 SRM conceptual design studies. Volume 1, Book 2: Preliminary development and verification plan
[NASA-CR-179054] N87-21036
The Taguchi approach to quality control and enhancement: A primer
[AD-A176571] N87-21364
Handbook for the Quality Assurance of Meteorological measurements
[PB87-140422] N87-21452
Analysis and quality of Alpine Experiment (ALPEX) data N87-21488
QUANTUM CHROMODYNAMICS
The octet nonleptonic Hamiltonian and current algebra on the lattice with Wilson fermions
[PREPRINT-525] N87-21636
Hadron phenomenology via the fire-string model
[PREPRINT-533] N87-21731
QUANTUM ELECTRONICS
Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems
[PREPRINT-542] N87-21674
QUANTUM MECHANICS
Technical activities 1986, Center for Basic Standards
[PB87-140315] N87-21651
QUANTUM THEORY
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Superlattice effects in graphite intercalation compounds
[AD-A176879] N87-21694
QUARKS
Magnetic moments of multiquark states and limit on the six-quark bag admixture in the deuteron wave function
[PREPRINT-537] N87-21673
QUENCHING (COOLING)
Kinetics and thermodynamics of quasicrystals as determined by surface modification techniques
[DE87-005538] N87-21713

R

RADAR
Activities report of the Department of Reconnaissance and Seeker Systems
[FOA-C-30433-3.1/3.2/3.3/3.4] N87-21227
A coordinate conversion algorithm for multisensor data processing
[AD-A176388] N87-21603
RADAR DATA
A quick look at the first NRL short pulse 95 GHz radar flight data
[AD-A176182] N87-21214
RADAR MEASUREMENT
A quick look at the first NRL short pulse 95 GHz radar flight data
[AD-A176182] N87-21214
Activities report in aerospace sciences
[ETN-87-99369] N87-21845
RADAR SCATTERING
A calibrtion procedure for a coherent polarimetric radar
[RSRE-MEMO-3889] N87-21211
RADAR TRACKING
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176862] N87-21433
RADIAL FLOW
Application of Doppler and transit laser anemometry in small turbomachines N87-21180
RADIANCE
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432
RADIANT FLUX DENSITY
Fast temporal correlation between hard X-ray and ultraviolet continuum brightenings N87-21812
RADIATION ABSORPTION
Compressive properties and laser absorptivity of unidirectional metal matrix composites
[AD-A176194] N87-21046
Electron-cyclotron maser emission during flares: Emission in various modes and temporal variations N87-21821

RADIATION EFFECTS
Fluxgate magnetometer analysis and simulation software for the Combined Release and Radiation Effects Satellite (CRRES)
[AD-A176353] N87-21032
Effects of irradiation on the fracture toughness of Alloy 718 plate and weld
[DE87-004345] N87-21102
USSR Report: Space Biology and Aerospace Medicine, Volume 20, No. 6, November - December 1986
[JPRS-USB-87-001] N87-21558
Direct and indirect effects of stationary magnetic field on biological systems N87-21574
RADIATION SHIELDING
Cosmic ray effects on microelectronics. Part 4
[AD-A176611] N87-21242
RADIATION TOLERANCE
Direct and indirect effects of stationary magnetic field on biological systems N87-21574
Radiosensitivity of escherichia coli following irradiation in a stationary magnetic field N87-21582
RADIATION TRANSPORT
Study of non-equilibrium transport phenomena
[NASA-CR-180441] N87-20965
RADIATIVE HEAT TRANSFER
Modeling the convection-radiation coupling in porous materials and identification of their radiation characteristics: Application to glass wools
[INSA-86-ISAL-0007] N87-21290
RADIO ASTRONOMY
Extremely rapid radio spikes in flares: A review N87-21798
Position measurements of rapidly fluctuating microwave bursts N87-21800
A Japanese plan: Large radio heliograph in the solar max no. 22 N87-21831
RADIO AURORAS
A new method of organizing spectral line intensity ratio fluctuations of auroral and nightglow emissions
[KGI-193] N87-21445
RADIO BEACONS
Canadian Coast Guard 406 MHz EPIRB (Emergency Position Indicating Radiobeacon) experimental results
[AD-A176430] N87-20978
RADIO BURSTS
Statistical analysis of fast hard X-ray bursts by SMM observations and microwave bursts by ground-based observations N87-21793
The role of narrowband dm-spikes in solar flares N87-21801
RADIO COMMUNICATION
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023
RADIO EMISSION
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023
RADIO FREQUENCIES
Precision tunable resonant microwave cavity
[NASA-CASE-LEW-13935-1] N87-21234
Evaluation of off-axis measurements performed in an anechoic chamber
[PB87-134367] N87-21658
RADIO NAVIGATION
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms
[AD-A176218] N87-20983
RADIO RELAY SYSTEMS
Algorithms used in ARROWS: Autodesign of radio relay optimum wideband systems
[PB87-126405] N87-21229
RADIO WAVES
Ground-wave analysis model for MF broadcast systems
[PB87-124293] N87-21228
Rapid Fluctuations in Solar Flares
[NASA-CP-2449] N87-21785
A study of starting time in great hard X-ray flares N87-21792
RADIOACTIVE DECAY
Neutral meson decays and the annihilation contribution
[PREPRINT-515] N87-21666
Light gluinos and fixed target experiments
[PREPRINT-526] N87-21668
RADIOACTIVE WASTES
Ductile iron data base. Correlations between microstructure and fracture toughness: Background document for draft ASTM ductile iron specification
[DE87-006010] N87-21107
RADIOACTIVITY
The application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce N87-21196
RADIOMETRIC CORRECTION
Comparison of long-wave and shortwave irradiances at satellite altitude with integrated scanner measurements using the Nimbus 7 ERB data set
[NASA-CR-177909] N87-21834
RAILGUN ACCELERATORS
Experimental results from railgun firings involving magnetic flux probes
[MRL-TN-509] N87-21008
The magnetic flux contributed by the plasma armature in an electromagnetic launcher
[MRL-R-1033] N87-21009
RAIN
Quick look Atlantic Ocean rain maps for gale
[NASA-CR-180511] N87-21533
RAMAN SPECTRA
Raman spectra of water in the translational and librational regions. Part 1: Study of the depolarization ratio
[PREPRINT-534] N87-21071
RAMAN SPECTROSCOPY
Raman spectra of water in the translational and librational regions. Part 1: Study of the depolarization ratio
[PREPRINT-534] N87-21071
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
Simultaneous temperature measurements with Raman and CARS in laminar flames N87-21171
CARS thermometry for low and high pressure combustion systems N87-21172
Accurate measurements of combustion species concentrations using CARS N87-21173
Nonlinearity and single shot noise problems in CARS spectroscopy N87-21174
Application of CARS thermometry to a turbulent flame N87-21175
Diesel engine combustion program at the Defence Research Establishment Ottawa
[AD-A176438] N87-21336
Activities report in physics
[ETN-87-99368] N87-21844
RAMJET ENGINES
Advanced B and Al combustion kinetics studies over wide temperature ranges
[AD-A176828] N87-21061
RANDOM NOISE
Low phase noise oscillator using two parallel connected amplifiers
[NASA-CASE-GSC-13018-1] N87-21232
RANDOM VIBRATION
La Recherche Aerospatiale, bimonthly bulletin, number 1986-2, 231/March-April
[ESA-TT-998] N87-20974
RANGEFINDING
Three-dimensional sensing and interpretation
[AD-A176906] N87-21340
RAPID QUENCHING (METALLURGY)
Microstructural response of rapidly solidified 304 stainless steel powder to three consolidation techniques
[DE87-000439] N87-21100
RARE GASES
Low noise lead screw positioner
[NASA-CASE-NPO-15617-1] N87-21304
A microscopic theory for the Brillouin intensities evaluation in noble gas crystals
[PREPRINT-521] N87-21721
Evaluation of Brillouin scattering intensities from rare gas crystals. Part 1: A pure dipole induced dipole theory
[PREPRINT-535] N87-21722
RATINGS
Comparison of the effects of broad-band noise on speech intelligibility and voice quality ratings
[AD-A176900] N87-21221
RAWINSONDES
The quality of the Alpine Experiment (ALPEX) 2b data set with regard to the application of vorticity dynamics N87-21490
RAY TRACING
Computational model for the simulation of millimeter-wave propagation through the clear atmosphere
[PB87-131173] N87-21209
REACTION KINETICS
Advanced B and Al combustion kinetics studies over wide temperature ranges
[AD-A176828] N87-21061
Kinetics of some gas phase elementary reactions of boron monofluoride
[AD-A167690] N87-21062
REACTOR MATERIALS
Technical basis for normal water chemistry guidlines: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
Assessment of ceramic composites for multimegawatt space nuclear power systems
[DE87-005272] N87-21675
READING
FY86 independent research/independent exploratory development
[AD-A176944] N87-21589
REAL TIME OPERATION
Rotary-wing aircraft terrain-following/terrain-avoidance system development
[NASA-TM-88323] N87-20982
A real-time expert system for control of an autonomous mobile robot and for diagnosing unexpected occurrences
[DE87-002411] N87-21345
Real-time expert system for the control of autonomous robot navigation in the presence of moving obstacles
[DE87-002167] N87-21350
Real-time expert system for control of an autonomous mobile robot including diagnosis of unexpected occurrences
[DE87-000385] N87-21354
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
FY86 independent research/independent exploratory development
[AD-A176944] N87-21589
Real time programming of a robot
[AD-A176782] N87-21616
Virtual-time operating-system functions for robotics application on a hypercube
[DE87-003658] N87-21618
Intelligent operating systems for autonomous robots: Real-time capabilities on a hypercube super-computer
[DE87-004076] N87-21620
RECEIVERS
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536
RECEPTION DIVERSITY
VHF radio broadcasting: Propagation and diversity reception of mixed polarised signals over a sea path
[BBC-RD-1987/2] N87-21208
RECOMBINATION REACTIONS
Computer modeling of high intensity solar cells
[DE87-005970] N87-21418
RECRYSTALLIZATION
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE87-006152] N87-21103
RECTANGULAR PLATES
The effects of curvature on the stiffness of laterally loaded rectangular plates
[NPL-DMA(A)-122] N87-21370
RECURSIVE FUNCTIONS
Symmetries and bi-Hamiltonian structures of 2+1 dimensional systems
[PREPRINT-536] N87-21644
Integrable 2+1 dimensional equations, their recursion operators and bi-Hamiltonian structures as reduction of multidimensional systems
[PREPRINT-540] N87-21645
REDUCED GRAVITY
The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement N87-21147
Numerical modelling of cryogenic propellant behavior in low-G N87-21148
Microgravity fluid management in two-phase thermal systems N87-21152
Microgravity fluid management requirements of advanced solar dynamic power systems N87-21153
Two-phase reduced gravity experiments for a space reactor design N87-21154
Shuttle get-away special experiments N87-21157
REDUCTION (CHEMISTRY)
The electrocatalysts of dioxygen reduction on transition metal chelates
[ETN-87-99584] N87-21070
REENTRY SHIELDING
Performance analysis of advanced spacecraft TPS
[NASA-CR-180496] N87-21011

REFLECTANCE
Comparison of long-wave and shortwave irradiances at satellite altitude with integrated scanner measurements using the Nimbus 7 ERB data set
[NASA-CR-177900] N87-21834
REFLECTOR ANTENNAS
Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna
[NASA-TM-89137] N87-21021
REFRACTIVITY
Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year-1
[AD-A176839] N87-21681
REFRACTORY MATERIALS
Compressive properties and laser absorptivity of unidirectional metal matrix composites
[AD-A176194] N87-21046
REFRIGERANTS
Flow properties of He3 in dilute He3-He4 mixtures at temperatures between 10 and 150 mK
[ETN-87-99582] N87-21300
REFRIGERATORS
Ten degree Kelvin hydride refrigerator
[NASA-CASE-NPO-16393-1-CU] N87-21159
REGENERATION (ENGINEERING)
High-throughput continuous cryopump
[DE87-000396] N87-21343
REGRESSION ANALYSIS
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
REINFORCED SHELLS
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
RELATIVISTIC EFFECTS
Relativistic (3+1) dimensional hydrodynamic simulations of compact interacting binary systems
[DE87-000602] N87-21771
RELATIVISTIC ELECTRON BEAMS
Millimeter wave generation by relativistic electron beams
[AD-A176949] N87-21245
RELATIVITY
Inflation in the universe, Circa 1986
[DE87-005399] N87-21778
RELAXATION METHOD (MATHEMATICS)
The quasi-linear relaxation of thick-target electron beams in solar flares N87-21625
RELEASING
Theoretical investigations of releases of lithium in the Earth's magnetosphere
[AD-A177080] N87-21437
RELIABILITY ENGINEERING
Reliability growth prediction
[AD-A176126] N87-21362
REMOTE CONTROL
Development of a telerobotic system for handling contaminated process equipment
[DE87-004186] N87-21346
REMOTE HANDLING
Development of a telerobotic system for handling contaminated process equipment
[DE87-004186] N87-21346
REMOTE SENSING
REGIS: An RAE experimental image-based geographic information system
[RAE-TR-84103] N87-21405
Foundations and applications of multispectral scanning in agriculture
[NLR-MP-85015-U] N87-21406
Remotely sensed sea surface temperature for the Alpine Experiment (ALPEX) — AVHRR-2 data N87-21497
Remote sensing of ocean sediment volume reverberation
[AD-A177186] N87-21546
REMOTE SENSORS
Hardware design for a fixed-wing airborne gravity measurement system
[AD-A176620] N87-20993
Remote sensing of ocean sediment volume reverberation
[AD-A177186] N87-21546
REMOTELY PILOTED VEHICLES
Hover performance of a remotely piloted helicopter
[AD-A176587] N87-20992
REPORTS
Solar-geophysical data number 507, November 1986. Part 1: (Prompt reports). Data for October, September 1986 and late data
[PB87-137766] N87-21448
Document preparation guide
[DE86-015042] N87-21736
REQUIREMENTS
Block 2 SRM conceptual design studies. Volume 1, Book 1: Appendix A: CEI specification CPW1-1900, Appendix B: Composite motor case
[NASA-CR-179049] N87-21035
RESCUE OPERATIONS
Canadian Coast Guard 406 MHz EPIRB (Emergency Position Indicating Radiobeacon) experimental results
[AD-A176430] N87-20978
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
RESEARCH AND DEVELOPMENT
Physics at the laser-atomic frontier
[PB87-126511] N87-21646
Research in planetary studies and operation of the Mauna Kea Observatory
[NASA-CR-180513] N87-21763
RESEARCH MANAGEMENT
Research on thermophysical properties of materials
[DE87-005882] N87-21084
Space experiment development process N87-21156
Directory of MIT (Massachusetts Institute of Technology) Sea Grant College Program publications, 1978-1986
[PB87-137105] N87-21550
The frontiers of physics (the next 25 years)
[DE87-004329] N87-21648
RESIDUAL STRESS
Effects of stresses on the phase transformation of NITINOL
[AD-A177053] N87-21090
Stress and efficiency studies in EFG
[NASA-CR-180527] N87-21412
RESILIENCE
Preimpregnated T5A-145-12-F584 carbon/epoxy from Hexcel-Genin: Elementary characterization
[PV-M5-517700] N87-21126
RESIN MATRIX COMPOSITES
Process for preparing phthalocyanine polymer from imide containing biaphthalonitrile
[NASA-CASE-ARC-11511-2] N87-21112
RESONANCE
Precision tunable resonant microwave cavity
[NASA-CASE-LEW-13935-1] N87-21234
RESONANT FREQUENCIES
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217
Wave propagation in periodic truss structures
[AD-A176548] N87-21381
Multi-point transient modal testing
[DE87-003880] N87-21394
Original improvements of the TLM method
[RAE-TRANS-2151] N87-21624
RESONANT VIBRATION
Multi-point transient modal testing
[DE87-003880] N87-21394
Study of the free oscillations of the Earth based on gravitional antenna data
[NOTA-INTERNA-868] N87-21447
RESOURCE ALLOCATION
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
RESPIRATION
Centrifuge testing of a G compensated/pressure demand oxygen regulator
[AD-A176117] N87-21587
EWAM: A model for predicting food and water ingestion, and inhalation rates of man
[DE86-900117] N87-21590
RETARDING
Handbook for using foams to control vapors from hazardous spills
[PB87-145660] N87-21421
RETROREFLECTORS
Low noise lead screw positioner
[NASA-CASE-NPO-15617-1] N87-21304
REVERBERATION
Remote sensing of ocean sediment volume reverberation
[AD-A177186] N87-21546
ROBOTICS
On impact dynamics of robotic operations
[AD-A176464] N87-21337
Development of a telerobotic system for handling contaminated process equipment
[DE87-004186] N87-21346
Manipulator Comparative Testing Program
[DE87-006026] N87-21355
Task execution control in assembly robot workcells
[LAAS-86-335] N87-21356
Contribution to the implementation of dynamic vision in the three-dimensional perception system of the HILARE robot
[CNRS-ORDER-959] N87-21357
Preliminary development head-neck simulator. Volume 2: Mathematical simulations
[PB87-142196] N87-21557
A flexible, computer-integrated robotic transfer system
[DE87-004183] N87-21619
ROBOTS
Modeling and experimental validation of a single-link flexible manipulator
[AD-A176614] N87-21338
The near-minimum time control of a robot arm
[AD-A176675] N87-21339
Three-dimensional sensing and interpretation
[AD-A176906] N87-21340
A real-time expert system for control of an autonomous mobile robot and for diagnosing unexpected occurrences
[DE87-002411] N87-21345
Real-time expert system for the control of autonomous robot navigation in the presence of moving obstacles
[DE87-002167] N87-21350
Advanced manipulation for autonomous mobile robots
[DE87-002818] N87-21351
Mobile robots in research and development programs at the Savannah River site
[DE87-003114] N87-21352
Real-time expert system for control of an autonomous mobile robot including diagnosis of unexpected occurrences
[DE87-000385] N87-21354
Real time programming of a robot
[AD-A176782] N87-21616
Virtual-time operating-system functions for robotics application on a hypercube
[DE87-003658] N87-21618
A flexible, computer-integrated robotic transfer system
[DE87-004183] N87-21619
Intelligent operating systems for autonomous robots: Real-time capabilities on a hypercube super-computer
[DE87-004076] N87-21620
ROCKET ENGINE CASES
Block 2 SRM conceptual design studies. Volume 1, Book 1: Conceptual design package
[NASA-CR-179048] N87-21034
Block 2 SRM conceptual design studies. Volume 1, Book 1: Appendix A: CEI specification CPW1-1900, Appendix B: Composite motor case
[NASA-CR-179049] N87-21035
ROCKET PROPELLANTS
Overview: Fluid acquisition and transfer N87-21146
ROCKET SOUNDING
Investigation of precipitating electrons during an auroral breakup
[KGI-PREPRINT-096] N87-21444
RODS
Design of dual phase steels for bars and rods
[DE87-003535] N87-21093
Quasi-containerless glass formation method and apparatus
[NASA-CASE-MFS-28090-1] N87-21111
Dynamics of flexible structures performing large overall motions: A geometrically-nonlinear approach N87-21335
Wave propagation in periodic truss structures
[AD-A176548] N87-21381
ROTARY STABILITY
Dual motion valve with single motion input
[NASA-CASE-MFS-28058-1] N87-21332
ROTARY WING AIRCRAFT
Rotary-wing aircraft terrain-following/terrain-avoidance system development
[NASA-TM-88323] N87-20982
ROTARY WINGS
A theoretical examination of a reentry capsule incorporating an autorotating rotor
[AD-A176854] N87-21026
ROTATING BODIES
The application of holography as a transonic flow diagnostic to rotating components in turbomachinery N87-21202
ROTATING FLUIDS
Laboratory simulation of rotating stratified flow over and around the Alps N87-21516
ROTATION
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264
ROTOR AERODYNAMICS
A theoretical examination of a reentry capsule incorporating an autorotating rotor
[AD-A176854] N87-21026

ROTORS
Grain boundary composition effects on environmentally induced cracking of engineering materials
[DE87-006405] N87-21105
Evaluation of L2F-measurements in unsteady turbine flow N87-21182
Wake interaction effects on the transition process on turbine blades
[AD-A177094] N87-21272
ROUTES
Extended Range Twin Operations (ETOPS) — twin engined aircraft
[CAP-513] N87-20976
The application of Computer Aided Design (CAD) techniques in a route-planning system
[NLR-MP-85039-U] N87-21605
RUNWAY CONDITIONS
Runway Visual Range (RVR) documentation of the civil airports in the Netherlands
[KNMI-TR-84] N87-20966
RURAL AREAS
Motor glider measurements during the urban atmosphere energy budget experiment (EESA 1)
N87-21464

S

S MATRIX THEORY
GANTRAS: A system of codes for the solution of the multigroup transport equation with a rigorous treatment of anisotropic neutron scattering. Plane and spherical geometry
[KFK-4163] N87-21665
SAFETY
The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary
[NASA-CR-178276] N87-21020
SAGE SATELLITE
Validation of SAM 2 and SAGE satellite
[NASA-CR-178256] N87-21429
SALINITY
Data from the Optical Dynamics Experiment (ODEX) R/V scania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535
SAMPLING
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
SANDS
Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21546
SARSAT
Canadian Coast Guard 406 MHz EPIRB (Emergency Position Indicating Radiobeacon) experimental results
[AD-A176430] N87-20978
SATELLITE CONTROL
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms
[AD-A176218] N87-20963
SATELLITE DESIGN
Towards an object oriented satellite test environment
[ETN-87-99476] N87-21031
SATELLITE IMAGERY
Meteosat contribution to Alpine Experiment (ALPEX): Highlights and limits N87-21495
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519
Quick look Atlantic Ocean rain maps for gale
[NASA-CR-180511] N87-21533
SATELLITE NETWORKS
Meteorological parameters derived from space-based observing systems, during the Global Weather Experiment and after N87-21475
Automatic mobile platforms — meteorological buoys
N87-21477
SATELLITE OBSERVATION
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
COSPAR's contribution to the early planning of the global observing system of the Global Weather Experiment
N87-21473
Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521
SATELLITE ORBITS
Retrieval of moving waves from polar orbiting satellite data N87-21404
SATELLITE SOUNDING
Improvements in geostationary satellite wind observations as a result of the Global Weather Experiment and applications of these in the context of the World Weather Watch (WWW) system N87-21476
Multivariate analyses of ALPEX satellite retrievals — Alpine Experiment (ALPEX) N87-21496
SATELLITE TRACKING
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
SATELLITE TRANSMISSION
Communication systems through artificial Earth satellites (selected pages)
[AD-A176940] N87-21028
SCALARS
Inflation in spherically symmetric inhomogeneous models
[DE87-005405] N87-21779
SCALE MODELS
Laboratory simulation of rotating stratified flow over and around the Alps N87-21516
SCALING LAWS
Nonlinear evolution equations, rescalings, model Partial Differential Equations (PDE's) and their integrability, 1
[PREPRINT-524] N87-21635
On the upper critical dimension in Anderson localization
[PREPRINT-514] N87-21638
SCANNING
Research on cryogenic vacuum tunneling
[AD-A176390] N87-21662
SCATTER PROPAGATION
Millimeter wave generation by relativistic electron beams
[AD-A176949] N87-21245
SCATTERING COEFFICIENTS
Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21546
SCATTEROMETERS
Testing of the advanced microwave instrument for the European Remote Sensing Satellite ERS-1
[ETN-87-99477] N87-21409
Microwave measurements of snow in Davos (Switzerland), May-June 1986
[FOA-C-30437-3.2] N87-21525
SCHEDULING
Exploiting loop level parallelism in nonprocedural dataflow programs
[NASA-CR-178277] N87-21613
SCHOOLS
Hover performance of a remotely piloted helicopter
[AD-A176587] N87-20992
SCHROEDINGER EQUATION
Hierarchies of integrable equations obtained as noniscospectral (in X and T) deformations of the Schroedinger spectral problem
[PREPRINT-522] N87-21633
On a new Darboux transformation for the construction of exact solutions of the Schroedinger equation
[PREPRINT-523] N87-21634
SCINTILLATION
Model results with PIIE (Polar Ionospheric Irregularities Experiment) rocket data
[AD-A176999] N87-21436
SCREWS
Low noise lead screw positioner
[NASA-CASE-NPO-15617-1] N87-21304
SEA SURFACE TEMPERATURE
Remotely sensed sea surface temperature for the Alpine Experiment (ALPEX) — AVHRR-2 data N87-21497
SEALS (STOPPERS)
Dual motion valve with single motion input
[NASA-CASE-MFS-28058-1] N87-21332
SEAMOUNTS
Characteristics of the two-dimensional spectrum of roughness on a seamount
[AD-A176366] N87-21538
SEARCHING
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
Rapid search for spherical objects in aerial photographs
[AD-A176391] N87-21406
SECONDARY RADAR
Developments in air traffic control systems and their relation with meteorology
[RAE-TRANS-2143] N87-20981
SEDIMENTS
Techniques to determine particulates in liquid fuels
[DE87-002028] N87-21135
SELECTION
How to select a laser velocimeter for a given application? N87-21179
SEMICONDUCTOR DEVICES
Rapid isothermal processing systems: An overview
[RSRE-MEMO-3967] N87-21238
MBE (Molecular Beam Epitaxy) growth of strained-layer superlattice device structures
[DE87-005881] N87-21711
SEMICONDUCTOR JUNCTIONS
Comparison between calculated and measured forward and reverse current-voltage characteristics
[AD-A176607] N87-21241
Pulsed excimer laser processing for cost-effective solar cells
[NASA-CR-180528] N87-21413
SEMICONDUCTORS (MATERIALS)
Picosecond laser pulse interactions with metallic and semiconductor surfaces
[AD-A176645] N87-21087
Fracture and hardness of semiconductor alloys
[AD-A176600] N87-21088
Field assisted etching
[RSRE-MEMO-3715] N87-21161
Nondestructive evaluation activities in the Semiconductor Materials and Processes Division
[PB87-140174] N87-21368
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces
[AD-A176445] N87-21691
Three-dimensional numerical studies of the physics of semiconductor crystal growth
[AD-A176808] N87-21693
The 2-4 semiconductor superlattices
[AD-A177092] N87-21696
Stress release in ion implanted lattice mismatched semiconductor heterostructures
[DE87-004518] N87-21703
Analysis of the magnetic properties of semimagnetic semiconductors. An experimental study
[ETN-87-99579] N87-21720
SENSORY PERCEPTION
Mathematical model of the otolith N87-21572
SEPARATED FLOW
Studies in non-linear unsteady aerodynamics
[AD-A177006] N87-20971
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer
[NASA-CR-4052] N87-21257
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions
[NASA-CR-180272] N87-21303
SERVICE LIFE
Design and development of a multi-kilowatt hour hydrogen/nickel oxide battery
[DE87-006774] N87-21250
Composite service life prediction via fiber bundle testing. Evaluation of testing equipment and data acquisition system
[AD-A176835] N87-21365
Stress and efficiency studies in EFG
[NASA-CR-180527] N87-21412
SERVOMECHANISMS
Modeling and control of the Stanford/JPL hand
[DE87-005847] N87-21353
Real time programming of a robot
[AD-A176782] N87-21616
SET THEORY
Some research problems in reliability theory and in limit theory
[AD-A176439] N87-21363
SHADOWGRAPH PHOTOGRAPHY
Automatic processing system for shadowgraph and interference patterns
[NASA-TM-88525] N87-21307
SHAPE CONTROL
OPUS: Optimal Projection for Uncertain Systems
[AD-A176820] N87-21025
SHAPE MEMORY ALLOYS
Effects of stresses on the phase transformation of NITINOL
[AD-A177053] N87-21090
SHAPES
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California
[AD-A176509] N87-20958

Net shape technology in aerospace structures. Volume 4, Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20980
Three-dimensional sensing and interpretation
[AD-A176906] N87-21340
Rapid search for spherical objects in aerial photographs
[AD-A176391] N87-21406
Automatic shape parameterisation in machine vision
[NPL-DITC-79/86] N87-21597

SHEAR PROPERTIES
Ductile fracture and random versus regular hole/void arrays
[AD-A176627] N87-21085
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539

SHEAR STRESS
Nonlinear viscoelastic analysis of adhesively bonded joints
[AD-A176494] N87-21379
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387

SHELL THEORY
Supermultiplets in Hilbert space for the supersymmetric bag model
[NIKHEF-H/86-5] N87-21664

SHELLS (STRUCTURAL FORMS)
Identification of material constants for a composite shell structure
[DE87-004524] N87-21395

SHIPS
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms
[AD-A176218] N87-20983
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985
Navigational Aid (NAVAID) vertical sounding system — atmospheric sounding N87-21479
Ship-borne systems for observing wind in the tropical zone N87-21480

SHOCK TUBES
Study of non-equilibrium transport phenomena
[NASA-CR-180441] N87-20965

SHOCK WAVE INTERACTION
Shock wave interaction with turbulence: Pseudospectral simulations
[DE87-004357] N87-21281

SHOCK WAVE PROPAGATION
Vorticity generation by shock propagation through bubbles in air
[AD-A176610] N87-21266
Shock acceleration of electrons and ions in solar flares N87-21823

SHOCK WAVES
Study of non-equilibrium transport phenomena
[NASA-CR-180441] N87-20965
Turbulent energy generated by accelerations and shocks
[DE87-002377] N87-21274
Development of a two-equation turbulent mix model
[DE87-005637] N87-21284
Modeling the interactions shock wave/turbulent boundary layer. Comparison of model with experiment
[ECL-86-16] N87-21291
Plasma physics abstracts, 1 January - 31 December, 1986
[NASA-CR-180220] N87-21684

SHORT WAVE RADIATION
Short wavelength laser/materials interactions
[AD-A176950] N87-21316

SIGNAL PROCESSING
Analysis of vibration data from WHL (Westland Helicopters Limited) Wessex fatigue test trial 3
[AD-A176208] N87-21003
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
Use of laser-Doppler-anemometry for the measurement of velocity distributions at the intake of a longitudinal flow heat exchanger
[JUEL-SPEZ-362] N87-21293
Multivariate analysis and its applications
[AD-A177019] N87-21637

SIGNAL TO NOISE RATIOS
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
Comparison of the effects of broad-band noise on speech intelligibility and voice quality ratings
[AD-A176900] N87-21221

SIGNAL TRANSMISSION
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536

SILANES
Contribution to the study of the epoxy-glass interfaces in glass fiber reinforced composites
[ECL-86-10] N87-21055

SILICON
Methods for thinning silicon chips
[RSRE-MEMO-3952] N87-21162
Large area sheet task: Advanced dendritic web growth development
[NASA-CR-180505] N87-21417
Three-dimensional numerical studies of the physics of semiconductor crystal growth
[AD-A176808] N87-21693
Characterization of on-chip polycrystalline silicon photoconductors
[DE87-003745] N87-21705

SILICON ALLOYS
High-temperature oxidation of alpha nickel-silicon alloys. Microstructures and mechanisms
[AD-A176211] N87-21079

SILICON CARBIDES
Plasma joining of metal matrix composites
[AD-A176690] N87-21042
Development of alumina- and mullite-SiC whisker composites: High temperature properties
[DE87-004624] N87-21052
Assessment of ceramic composites for multimegawatt space nuclear power systems
[DE87-005272] N87-21675

SILICON DIOXIDE
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys
[AD-A176970] N87-21089
Contribution to understanding and modeling hot carrier injection phenomena in submicron MOS devices
[ECL-86-12] N87-21717

SILICON FILMS
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys
[AD-A176970] N87-21089
Stress and efficiency studies in EFG
[NASA-CR-180527] N87-21412
Analysis of the feasibility of silicon on insulator submicron CMOS technology
[ECL-86-07] N87-21716

SILVER
Method for forming hermetic seals
[NASA-CASE-NPO-16423-1-CU] N87-21334

SIMULATION
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039
Toward the large-eddy simulations of compressible turbulent flows
[NASA-CR-178273] N87-21259
Time-dependent simulation of small-scale turbulent mixing and reaction
[PB87-140257] N87-21302
Theoretical investigations of releases of lithium in the Earth's magnetosphere
[AD-A177080] N87-21437
Vortices in long Josephson junctions
[AD-A176916] N87-21695
Persistent time intervals between features in solar flare hard X-ray emission N87-21790

SIMULATORS
Fault tolerant electrical power system. Phase 1: Study
[AD-A177061-PH-1] N87-21246
Preliminary development, head-neck simulator. Volume 1: Analysis volunteer tests
[PB87-133245] N87-21553

SINGLE CRYSTALS
Polydiacetylene single crystal fibres and their use in fibre-reinforced composites
[AD-A176927] N87-21049

SIZE DISTRIBUTION
Creep cavitation in a nickel aluminide
[DE87-004392] N87-21106

SKIN FRICTION
La Recherche Aerospatiale, bimonthly bulletin, number 1986-2, 231/March-April
[ESA-TT-998] N87-20974
Viscous flow around wall mounted obstacles
[ARL-AERO-PROP-REPT-172] N87-21260

SLEEP DEPRIVATION
Sleep deprivation and exercise tolerance
[AD-A176171] N87-21555

SLIDING
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387

SLOTS
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217

SNOW
Microwave measurements of snow in Davos (Switzerland), May-June 1986
[FOA-C-30437-3.2] N87-21525

SNOW COVER
Snow depths in the Netherlands from measurements at synoptic stations in 1955 and in the period 1978-1984
[KNMI-TR-51A] N87-21522

SOCIAL ISOLATION
Group dynamics and performance efficiency under extreme conditions N87-21578

SODIUM VAPOR
Behavior of UO2 and fission in sodium vapor atmosphere at temperatures up to 2800 C — reactor core disassembly
[KFK-4135] N87-21677

SOFTWARE ENGINEERING
Introduction to MASCOT 3
[ARE-TM(UDP)-86102] N87-21598
An evaluation of the Flex programming support environment
[RSRE-86003] N87-21600
Integrity and the Flex programming support environment
[RSRE-MEMO-3915] N87-21601

SOFTWARE TOOLS
Biosphere-Atmosphere Transfer Scheme (BATS) for the NCAR (National Center for Atmospheric Research) community climate model
[PB87-141511] N87-21530
Introduction to MASCOT 3
[ARE-TM(UDP)-86102] N87-21598
Ten 15: An overview — abstract machine
[RSRE-MEMO-3977] N87-21599
An evaluation of the Flex programming support environment
[RSRE-86003] N87-21600
Integrity and the Flex programming support environment
[RSRE-MEMO-3915] N87-21601
Guidance on software package selection
[PB87-140810] N87-21610

SOLAR ACTIVITY
Solar-geophysical data number 507, November 1986. Part 1: (Prompt reports). Data for October, September 1986 and late data
[PB87-137766] N87-21448
Solar-geophysical data number 507, November 1986. Part 2: (Comprehensive Reports). Data for May 1986 and miscellanea
[PB87-137774] N87-21449
Solar microwave millisecond spike at 2.84 GHz N87-21809
On the 152-day periodicity of the solar flare occurrence rate
[NASA-CR-180519] N87-21838
Classification of solar flares and relationship between the first and second phases
[NASA-CR-180221] N87-21839

SOLAR ATMOSPHERE
Fast temporal correlation between hard X-ray and ultraviolet continuum brightenings N87-21812

SOLAR CELLS
High efficiency crystalline silicon solar cells
[NASA-CR-180530] N87-21411
Pulsed excimer laser processing for cost-effective solar cells
[NASA-CR-180528] N87-21413
Computer modeling of high intensity solar cells
[DE87-005970] N87-21416

SOLAR CORONA
Rapid fluctuations in solar flares N87-21786
Interpretation of rapid rises in hard X-rays and microwaves with the thermal conduction front model N87-21788
Microwave and hard X-ray emissions during the impulsive phase of solar flares: Nonthermal electron spectrum and time delay N87-21794
Impulsively generated fast coronal pulsations N87-21822
The quasi-linear relaxation of thick-target electron beams in solar flares N87-21825

A double layer model for solar X-ray and microwave pulsations N87-21829
White light solar corona: An atlas of 1985 K-coronameter synoptic charts, December 1984 - December 1985 [PB87-138095] N87-21837
Classification of solar flares and relationship between the first and second phases [NASA-CR-180221] N87-21839

SOLAR COSMIC RAYS
Solar wind plasma in the magnetosphere method of entry and consequences [AD-A177255] N87-21835

SOLAR DYNAMIC POWER SYSTEMS
Microgravity fluid management requirements of advanced solar dynamic power systems N87-21153

SOLAR ELECTRONS
Electron-cyclotron maser and solar microwave millisecond spike emission N87-21819

SOLAR ENERGY CONVERSION
Bidirectional control system for energy flow in solar powered flywheel [NASA-CASE-MFS-25978-1] N87-21410

SOLAR FLARES
Solar-geophysical data number 507, November 1986. Part 2: (Comprehensive Reports). Data for May 1986 and miscellanea [PB87-137774] N87-21449
Rapid Fluctuations in Solar Flares [NASA-CP-2449] N87-21785
Rapid fluctuations in solar flares N87-21786
Sub-second variations of high energy (300 keV) hard X-ray emission from solar flares N87-21787
Impulsive phase solar flare X-ray polarimetry N87-21789
Persistent time intervals between features in solar flare hard X-ray emission N87-21790
Evidence for beamed electrons in a limb X-ray flare observed by Hard X-Ray Imaging Spectrometer (HXIS) N87-21791
A study of starting time in great hard X-ray flares N87-21792
Statistical analysis of fast hard X-ray bursts by SMM observations and microwave bursts by ground-based observations N87-21793
Microwave and hard X-ray emissions during the impulsive phase of solar flares: Nonthermal electron spectrum and time delay N87-21794
Hard X-ray imaging observation of fluctuating bursts N87-21795
Hard X-ray delays N87-21796
Fast fluctuations of soft X-rays from active regions N87-21797
Relation between solar narrow-band decimeter wave bursts and associated X-ray bursts N87-21799
Position measurements of rapidly fluctuating microwave bursts N87-21800
The role of narrowband dm-spikes in solar flares N87-21801
The possible importance of synchrotron/inverse Compton losses to explain fast mm-wave and hard X-ray emission of a solar event N87-21802
Rapid spectral and flux time variations in a solar burst observed at various dm-mm wavelengths and at hard X-rays N87-21803
Quasi-periodic pulsations in solar hard X-ray and microwave flares N87-21804
Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares N87-21805
The microwave spectrum of solar millisecond spikes N87-21806
Solar VLBI N87-21807
A search for fast variations in the Fe XXI emission during solar flares N87-21811
Comparison of solar hard X-ray and UV line and continuum bursts with high time resolution N87-21813
OV and hard X-rays, observations and model calculations N87-21814
Rapid soft X-ray fluctuations in solar flares observed with the X-ray polychromator N87-21815
Soft X-ray oscillations during the flare of 7 August 1972 N87-21816
Rapid changes in H alpha-flares correlated with microwaves N87-21817
Plasma turbulence and impulsive UV line emission in solar flares N87-21818
Electron-cyclotron maser and solar microwave millisecond spike emission N87-21819
The effect of beam-driven return current instability on solar hard X-ray bursts N87-21820
Electron-cyclotron maser emission during flares: Emission in various modes and temporal variations N87-21821
Impulsively generated fast coronal pulsations N87-21822
Shock acceleration of electrons and ions in solar flares N87-21823
The generation of rapid solar flare hard X-ray and microwave fluctuations in current sheets N87-21824
The quasi-linear relaxation of thick-target electron beams in solar flares N87-21825
The propagation of solar flare particles in a coronal loop N87-21826
Signatures of current loop coalescence in solar flares N87-21827
Thermal waves or beam heating in the 1980, November 5 flare N87-21828
A double layer model for solar X-ray and microwave pulsations N87-21829
Theoretical studies on rapid fluctuations in solar flares N87-21830
A Japanese plan: Large radio heliograph in the solar max no. 22 N87-21831
The HESP (High Energy Solar Physics) project N87-21832
The proposed NRAO millimeter array and its use for solar studies N87-21833
Solar-geophysical data number 506, October 1986. Part 2: (Comprehensive reports). Data for April 1986 [PB87-126397] N87-21836
On the 152-day periodicity of the solar flare occurrence rate [NASA-CR-180519] N87-21838
Classification of solar flares and relationship between the first and second phases [NASA-CR-180221] N87-21839

SOLAR FLUX DENSITY
Soft X-ray oscillations during the flare of 7 August 1972 N87-21816
Rapid changes in H alpha-flares correlated with microwaves N87-21817
Plasma turbulence and impulsive UV line emission in solar flares N87-21818
Electron-cyclotron maser and solar microwave millisecond spike emission N87-21819
Thermal waves or beam heating in the 1980, November 5 flare N87-21828
A double layer model for solar X-ray and microwave pulsations N87-21829

SOLAR LIMB
Evidence for beamed electrons in a limb X-ray flare observed by Hard X-Ray Imaging Spectrometer (HXIS) N87-21791

SOLAR OBSERVATORIES
The HESP (High Energy Solar Physics) project N87-21832

SOLAR OSCILLATIONS
Soft X-ray oscillations during the flare of 7 August 1972 N87-21816
Rapid changes in H alpha-flares correlated with microwaves N87-21817
Impulsively generated fast coronal pulsations N87-21822
The generation of rapid solar flare hard X-ray and microwave fluctuations in current sheets N87-21824
Signatures of current loop coalescence in solar flares N87-21827
Theoretical studies on rapid fluctuations in solar flares N87-21830

SOLAR PHYSICS
The HESP (High Energy Solar Physics) project N87-21832

SOLAR PROMINENCES
Solar-geophysical data number 506, October 1986. Part 2: (Comprehensive reports). Data for April 1986 [PB87-126397] N87-21836

SOLAR RADIATION
The possible importance of synchrotron/inverse Compton losses to explain fast mm-wave and hard X-ray emission of a solar event N87-21802
Rapid spectral and flux time variations in a solar burst observed at various dm-mm wavelengths and at hard X-rays N87-21803

SOLAR RADIO BURSTS
A study of starting time in great hard X-ray flares N87-21792
Comparison of solar hard X-ray and UV line and continuum bursts with high time resolution N87-21813
Rapid soft X-ray fluctuations in solar flares observed with the X-ray polychromator N87-21815
The effect of beam-driven return current instability on solar hard X-ray bursts N87-21820
Electron-cyclotron maser emission during flares: Emission in various modes and temporal variations N87-21821
Impulsively generated fast coronal pulsations N87-21822
The quasi-linear relaxation of thick-target electron beams in solar flares N87-21825
Theoretical studies on rapid fluctuations in solar flares N87-21830
Solar-geophysical data number 506, October 1986. Part 2: (Comprehensive reports). Data for April 1986 [PB87-126397] N87-21836

SOLAR RADIO EMISSION
Extremely rapid radio spikes in flares: A review N87-21798
The microwave spectrum of solar millisecond spikes N87-21806
Temporal frequency of radio emissions for the April 25, 1984 flare N87-21808

SOLAR SPECTRA
Rapid soft X-ray fluctuations in solar flares observed with the X-ray polychromator N87-21815
Rapid changes in H alpha-flares correlated with microwaves N87-21817
Shock acceleration of electrons and ions in solar flares N87-21823
Signatures of current loop coalescence in solar flares N87-21827

SOLAR SPECTROMETERS
A Japanese plan: Large radio heliograph in the solar max no. 22 N87-21831

SOLAR WIND
Plasma physics abstracts, 1 January - 31 December, 1986 [NASA-CR-180220] N87-21684
Plasma turbulence and impulsive UV line emission in solar flares N87-21818
The propagation of solar flare particles in a coronal loop N87-21826
Solar wind plasma in the magnetosphere method of entry and consequences [AD-A177255] N87-21835

SOLAR X-RAYS
Fast temporal correlation between hard X-ray and ultraviolet continuum brightenings N87-21812
Comparison of solar hard X-ray and UV line and continuum bursts with high time resolution N87-21813
OV and hard X-rays, observations and model calculations N87-21814
Rapid soft X-ray fluctuations in solar flares observed with the X-ray polychromator N87-21815
Soft X-ray oscillations during the flare of 7 August 1972 N87-21816
The effect of beam-driven return current instability on solar hard X-ray bursts N87-21820
The generation of rapid solar flare hard X-ray and microwave fluctuations in current sheets N87-21824
The quasi-linear relaxation of thick-target electron beams in solar flares N87-21825
The propagation of solar flare particles in a coronal loop N87-21826
Thermal waves or beam heating in the 1980, November 5 flare N87-21828
A double layer model for solar X-ray and microwave pulsations N87-21829
A Japanese plan: Large radio heliograph in the solar max no. 22 N87-21831
The HESP (High Energy Solar Physics) project N87-21832

SOLID ELECTROLYTES
Derivation of working equations of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte with consideration of extracted oxygen N87-21575
Calculation of equilibrated concentrations of constituents of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte and corresponding values of theoretical voltage of dissociation N87-21576

SOLID PROPELLANT COMBUSTION
Holographic investigation of metallized solid propellant combustion in a three-dimensional motor [AD-A176140] N87-21131
Implementation of three speckle reduction filters for solid propellant combustion holograms [AD-A176563] N87-21132

SOLID PROPELLANT ROCKET ENGINES
Filament wound data base development, revision 1 [NASA-CR-179068-REV-1] N87-21016
Holographic investigation of metallized solid propellant combustion in a three-dimensional motor [AD-A176140] N87-21131

SOLID PROPELLANTS
Holographic investigation of metallized solid propellant combustion in a three-dimensional motor [AD-A176140] N87-21131

SOLID ROCKET PROPELLANTS
Advanced B and Al combustion kinetics studies over wide temperature ranges [AD-A176828] N87-21081
Size and shape of solid fuel diffusion flames in very low speed flows [NASA-CR-179576] N87-21129

A solid propellant charge design with negative effective pressure exponent using forced cone burning
[WSRL-0469-TR] N87-21130
Holographic investigation of metallized solid propellant combustion in a three-dimensional motor
[AD-A176140] N87-21131
Implementation of three speckle reduction filters for solid propellant combustion holograms
[AD-A176583] N87-21132

SOLID STATE
State equation of condensed materials: Physical principles and applications
[ECL-86-15] N87-21069
Crystal data: Version 1.0 database specifications
[PB87-140414] N87-21724

SOLID STATE DEVICES
Basic research in electronics: Joint Services Electronics Program (JSEP)
[AD-A177067] N87-21247

SOLIDIFICATION
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys
[AD-A176970] N87-21089
Microstructural response of rapidly solidified 304 stainless steel powder to three consolidation techniques
[DE87-000439] N87-21100
Analysis of picosecond pulsed laser melted graphite
[DE87-003755] N87-21124

SOLIDIFIED GASES
A microscopic theory for the Brillouin intensities evaluation in noble gas crystals
[PREPRINT-521] N87-21721
Evaluation of Brillouin scattering intensities from rare gas crystals. Part 1: A pure dipole induced dipole theory
[PREPRINT-535] N87-21722

SOLVENT EXTRACTION
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE87-004004] N87-21065
Laser light-scattering and laser fluorescence studies of solvent extraction systems
[DE87-003910] N87-21321

SOUND FIELDS
Acoustic-mean flow interactions
[AD-A176845] N87-21038
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536

SOUND TRANSMISSION
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655

SOUND WAVES
Ultrasonic cure characterization of epoxy resins: Constitutive modeling
[AD-A176661] N87-21116
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539
Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21546
Acoustic radiation stress measurement
[NASA-CASE-LAR-13440-1] N87-21653
Versatile three-dimensional Hamiltonian ray-tracing program for acoustic waves in the atmosphere above irregular terrain
[PB87-115804] N87-21659

SPACE CAPSULES
A theoretical examination of a reentry capsule incorporating an autorotating rotor
[AD-A176854] N87-21026

SPACE CHARGE
Space-charge-induced breakdown in dielectrics
[AD-A176969] N87-21029

SPACE COMMERCIALIZATION
The NASA Electric Propulsion Program
[NASA-TM-89856] N87-21037

SPACE COMMUNICATION
Communication systems through artificial Earth satellites (selected pages)
[AD-A176940] N87-21028

SPACE ENVIRONMENT SIMULATION
Variable energy, high flux, ground-state atomic oxygen source
[NASA-CASE-NPO-16640-1-CU] N87-21661

SPACE EXPLORATION
The NASA Electric Propulsion Program
[NASA-TM-89856] N87-21037

SPACE FLIGHT
Superfluid helium on orbit transfer (SHOOT)
N87-21151
Two-phase reduced gravity experiments for a space reactor design N87-21154

SPACE FLIGHT STRESS
USSR Report: Space Biology and Aerospace Medicine, Volume 20, No. 6, November - December 1986
[JPRS-USB-87-001] N87-21558
Effect of spaceflight factors on hemopoiesis
N87-21560
Evaluation of functional state of pilots on the basis of interhemispheric asymmetry N87-21561

SPACE LAW
Present and future military uses of outer space: International law, politics, and the practice of states
[AD-A176722] N87-21753
Space stations and the law: Selected legal issues
[PB87-118220] N87-21754

SPACE POWER REACTORS
Two-phase reduced gravity experiments for a space reactor design N87-21154

SPACE PROCESSING
Fiber glass pulling — in space
[NASA-CR-179036] N87-21140

SPACE SHUTTLE BOOSTERS
Block 2 SRM conceptual design studies. Volume 1, Book 1: Conceptual design package
[NASA-CR-179048] N87-21034
Block 2 SRM conceptual design studies. Volume 1, Book 1: Appendix A: CEI specification CPW1-1900, Appendix B: Composite motor case
[NASA-CR-179049] N87-21035
Block 2 SRM conceptual design studies. Volume 1, Book 2: Preliminary development and verification plan
[NASA-CR-179054] N87-21036

SPACE SHUTTLE PAYLOADS
Shuttle middeck fluid transfer experiment: Lessons learned N87-21158
The physical origins of the cosmic ultraviolet background N87-21840

SPACE SHUTTLES
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 1
[NASA-CR-179074] N87-21012
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 3
[NASA-CR-179076] N87-21013
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 2
[NASA-CR-179075] N87-21014
Space experiment development process N87-21156
Shuttle get-away special experiments N87-21157
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519

SPACE STATIONS
Wave-mode coordinates and scattering matrices for wave propagation
[AD-A176998] N87-21030
Space station experiment definition: Long term cryogenic fluid storage N87-21144
Maintenance evaluation for space station liquid systems N87-21155
Impact verification of space suit design for space station
[NASA-CR-180456] N87-21584
Space station group activities habitability module study
[NASA-CR-4010] N87-21585
Space stations and the law: Selected legal issues
[PB87-118220] N87-21754

SPACE SUITS
Impact verification of space suit design for space station
[NASA-CR-180456] N87-21584

SPACE WEAPONS
Induction linear accelerator technology for SDIO applications
[DE87-003251] N87-21642
Advanced sensors, telecommunications and data processing: Technological spin-offs from the Strategic Defense Initiative
[DE87-003384] N87-21757

SPACE-TIME FUNCTIONS
A new methodology of determining directional albedo models from Nimbus 7 ERB scanning radiometer measurements
[NASA-CR-177908] N87-21764

SPACEBORNE ASTRONOMY
The HESP (High Energy Solar Physics) project
N87-21832

SPACEBORNE TELESCOPES
Self indexing latch system
[NASA-CASE-MFS-25956-1] N87-21333
Ad astra HIPPARCOS. Astronomical mission of the European Space Agency
[ESA-BR-24] N87-21766

SPACECRAFT CHARGING
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft
[AD-A176815] N87-21024
Progress toward predicting high-voltage charging of spacecraft in low polar orbit
[AD-A176939] N87-21027
Space-charge-induced breakdown in dielectrics
[AD-A176969] N87-21029

SPACECRAFT COMMUNICATION
Measurement apparatus and procedure for the determination of surface emissivities
[NASA-CASE-LAR-13455-1] N87-21206
Reed-Solomon decoder
[NASA-CASE-NPO-15982-1] N87-21591

SPACECRAFT CONSTRUCTION MATERIALS
Activities report in materials
[ETN-87-99374] N87-21054

SPACECRAFT DEFENSE
Advanced sensors, telecommunications and data processing: Technological spin-offs from the Strategic Defense Initiative
[DE87-003884] N87-21757

SPACECRAFT DESIGN
Orbital transfer vehicle concept definition and system analysis study. Volume 1A: Executive summary. Phase 2
[NASA-CR-179055] N87-21018
Mars Observer: Phase 0 safety review data package
[NASA-CR-180526] N87-21019

SPACECRAFT MODULES
Space station group activities habitability module study
[NASA-CR-4010] N87-21585

SPACECRAFT ORBITS
Progress toward predicting high-voltage charging of spacecraft in low polar orbit
[AD-A176939] N87-21027

SPACECRAFT POWER SUPPLIES
Bidirectional control system for energy flow in solar powered flywheel
[NASA-CASE-MFS-25978-1] N87-21410
Assessment of ceramic composites for multimegawatt space nuclear power systems
[DE87-005272] N87-21675
A 1987 overview of free-piston Stirling technology for space power application
[NASA-TM-89832] N87-21756

SPACECRAFT PROPULSION
Orbital transfer vehicle concept definition and system analysis study. Volume 1A: Executive summary. Phase 2
[NASA-CR-179055] N87-21018

SPACECRAFT REENTRY
Performance analysis of advanced spacecraft TPS
[NASA-CR-180496] N87-21011

SPACECRAFT SHIELDING
Performance analysis of advanced spacecraft TPS
[NASA-CR-180496] N87-21011

SPACECRAFT STABILITY
The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement N87-21147

SPACECRAFT STRUCTURES
Activities report in structures
[ETN-87-99375] N87-21166

SPARK GAPS
Spectral signatures from short-pulse microwave air breakdown
[DE87-006116] N87-21686

SPATIAL DISTRIBUTION
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537

SPATIAL MARCHING
A spatial marching technique for the inviscid blunt body problem
[DE87-004526] N87-20972

SPATIAL RESOLUTION
Extremely rapid radio spikes in flares: A review
N87-21798

SPECKLE PATTERNS
Vibration analysis by speckle interferometry
N87-21197

SPECTRA
Improvement of fatigue life prediction accuracy for various realistic loading spectra by use of correction factors
[TAE-581] N87-21374

SPECTRAL EMISSION
Rapid spectral and flux time variations in a solar burst observed at various dm-mm wavelengths and at hard X-rays N87-21803

SPECTRAL ENERGY DISTRIBUTION
A new method of organizing spectral line intensity ratio fluctuations of auroral and nightglow emissions
[KGI-193] N87-21445

SPECTRAL METHODS
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 2: Manifestations of the mechanisms related to large oriented structures in homogeneous turbulence. Part A: Experimental study. Part B: Theoretical study
[ETN-87-99395] N87-21294
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 3: Spectral manifestations of inhomogeneity due to field effects and to the presence of walls
[ETN-87-99396] N87-21295
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 4: Study of entrainment mechanisms using simulations and experimental results
[ETN-87-99397] N87-21296
SPECTRAL REFLECTANCE
Spectral reflectance (0.4 - 5.0 microns) of sulfur related compounds and mixtures
[NASA-CR-180525] N87-21781
SPECTRAL SENSITIVITY
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432
SPECTRAL SIGNATURES
The study of combustion by means of diode laser spectroscopy N87-21201
Spectral signatures from short-pulse microwave air breakdown
[DE87-006116] N87-21686
SPECTROHELIOGRAPHS
A Japanese plan: Large radio heliograph in the solar max no. 22 N87-21831
SPECTROPHOTOMETRY
A new method of organizing spectral line intensity ratio fluctuations of auroral and nightglow emissions
[KGI-193] N87-21445
SPECTROSCOPY
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE87-004004] N87-21065
SPECTRUM ANALYSIS
Hierarchies of integrable equations obtained as nonisopectral (in X and T) deformations of the Schroedinger spectral problem
[PREPRINT-522] N87-21633
Quasi-periodic pulsations in solar hard X-ray and microwave flares N87-21804
Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares N87-21805
SPECULAR REFLECTION
Implementation of three speckle reduction filters for solid propellant combustion holograms
[AD-A176583] N87-21132
SPEECH
Comparison of the effects of broad-band noise on speech intelligibility and voice quality ratings
[AD-A176900] N87-21221
SPEECH RECOGNITION
Multispeaker number recognition
[ENST-86E008] N87-21225
Analysis and restitution of voice signals using evolving models
[ENST-86E009] N87-21226
SPENT FUELS
Ductile iron data base. Correlations between microstructure and fracture toughness: Background document for draft ASTM ductile iron specification
[DE87-006010] N87-21107
SPHERES
On the artificial viscosity in 1D spherical geometry
[DE87-004449] N87-21279
Rapid search for spherical objects in aerial photographs
[AD-A176391] N87-21406
Test of FORTRAN program for sound scattering by layered sphere
[ARE-TM(UHA)-86518] N87-21654
Inflation in spherically symmetric inhomogeneous models
[DE87-005405] N87-21779
SPHERICAL COORDINATES
Solution of the steady state incompressible Navier-Stokes equations in curvilinear nonorthogonal coordinates
[VKI-TN-158] N87-21297
SPHERICAL HARMONICS
The representation of the Earth's gravitational potential in a spherical harmonic expension to degree 250
[AD-A176479] N87-21431
SPHERICAL SHELLS
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
Acoustic emission point source locations on thin spherical shell
[DE87-004015] N87-21393
SPIKES
Hard X-ray imaging observation of fluctuating bursts N87-21795
Hard X-ray delays N87-21796
Fast fluctuations of soft X-rays from active regions N87-21797
Extremely rapid radio spikes in flares: A review N87-21798
Relation between solar narrow-band decimeter wave bursts and associated X-ray bursts N87-21799
Position measurements of rapidly fluctuating microwave bursts N87-21800
The role of narrowband dm-spikes in solar flares N87-21801
Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares N87-21805
Solar VLBI N87-21807
Solar microwave millisecond spike at 2.84 GHz N87-21809
SPILLING
Handbook for using foams to control vapors from hazardous spills
[PB87-145660] N87-21421
SPIN DYNAMICS
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262
SPIN GLASS
Analysis of the magnetic properties of semimagnetic semiconductors. An experimental study
[ETN-87-99579] N87-21720
SPIRAL GALAXIES
The physical origins of the cosmic ultraviolet background N87-21840
SPLINE FUNCTIONS
Data approximation by splines in one and two independent variables
[NPL-DITC-77/86] N87-21623
SPONGES (MATERIALS)
Mechanical properties of elementally blended Ti-6Al-4V
[AD-A176640] N87-21086
SPRAYERS
Liquid seeding atomizer
[NASA-CASE-ARC-11631-1] N87-21255
SPREAD F
Spread F: The Scandinavian scene
[UIO-SR-86-02] N87-21443
SPUTTERING
Investigations into the origins of the physical structure of thin films
[AD-A176943] N87-21117
Ion beam sputter etching
[NASA-CASE-LEW-13899-1] N87-21160
STABILITY
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136
Stability of the vortex motion in oscillating flow
[AD-A176629] N87-21267
Saturation effects in coupled lasers with homogeneous gain
[AD-A176843] N87-21314
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539
STABILIZATION
A simple method for electronic feedback stabilization of an actively modelocked and Q-switched Nd:YLF laser
[DE87-002823] N87-21325
Stabilization and control problems in structural dynamics
[AD-A177183] N87-21389
STABILIZERS (FLUID DYNAMICS)
Experimental determination of the stable-trim attitudes of two proposed, general-purpose, heat-source modules
[NASA-TM-88345] N87-20967
STAINLESS STEELS
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
Microstructural response of rapidly solidified 304 stainless steel powder to three consolidation techniques
[DE87-000439] N87-21100
Inertia friction welding of 1100 aluminum to type 316 stainless steel
[DE87-005044] N87-21347
Fusion technology projects
[ECN-185] N87-21689
STANDARDS
Gravimetric technique for the preparation of accurate trace organic gas standards
[PB87-145736] N87-21074
Application of a high-precision universal measuring machine in Standards Laboratory measurements
[DE87-003036] N87-21308
Nondestructive evaluation activities in the Semiconductor Materials and Processes Division
[PB87-140174] N87-21368
Preliminary report on candidates for AGARD standard aeroelastic configurations for dynamic response
[NASA-TM-89142] N87-21376
Handbook for the Quality Assurance of Meteorological measurements
[PB87-140422] N87-21452
Journal of Research of the National Bureau of Standards, Volume 91, Number 4, July-August 1986
[PB87-109664] N87-21649
Journal of Research of the National Bureau of Standards, Volume 91, Number 6, November-December 1986
[PB87-137154] N87-21650
Technical activities 1986, Center for Basic Standards
[PB87-140315] N87-21651
Document preparation guide
[DE86-015942] N87-21738
Publications of the National Bureau of Standards, 1985 catalog
[PB87-145272] N87-21751
STANDING WAVES
Normal wave propagation velocity in a static web
[AD-A176539] N87-21380
STAR CLUSTERS
Astronomical observations of the 807 GHz CO J = 7-6 rotational line with a new heterodyne spectrometer N87-21759
STAR FORMATION
Dynamical evolution of spherical stellar systems N87-21767
STATIC DEFORMATION
Acoustic radiation stress measurement
[NASA-CASE-LAR-13440-1] N87-21653
STATIC LOADS
The micromechanics of damage initiation and development under static and fatigue loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99985] N87-21044
STATIC TESTS
A comparison of the fatigue performance of woven and non-woven CFRP laminates
[RAE-TR-85059] N87-21041
Resistance curve approach to predicting residual strength of composites
[AD-A176984] N87-21050
STATISTICAL ANALYSIS
Reliability growth prediction
[AD-A176128] N87-21362
STARPAC: The standard times series and regression package
[PB87-152385] N87-21641
Persistent time intervals between features in solar flare hard X-ray emission N87-21790
Statistical analysis of fast hard X-ray bursts by SMM observations and microwave bursts by ground-based observations N87-21793
Temporal frequency of radio emissions for the April 25, 1984 flare N87-21808
Solar microwave millisecond spike at 2.84 GHz N87-21809
A search for fast variations in the Fe XXI emission during solar flares N87-21811
STATISTICAL DISTRIBUTIONS
Some research problems in reliability theory and in limit theory
[AD-A176439] N87-21363
STATORS
Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor N87-21181
Evaluation of L2F-measurements in unsteady turbine flow N87-21182
STEADY STATE
Solution of the steady state incompressible Navier-Stokes equations in curvilinear nonorthogonal coordinates
[VKI-TN-158] N87-21297

STEEL STRUCTURES
Fatigue crack growth under cyclic compression: Role of first load cycle
[FFA-TN-1986-71] N87-21396
Mechanical properties of welded joints in two fine-grained steels with yield strength of 370 N/mm(sup)2
[VTT-441] N87-21399
STEELS
Analysis of plasma-nitrided steels
[NASA-TM-89815] N87-21078
Performance test of 110 mm bore ball bearing made from corrosion resistant powdered steel
[AD-A177060] N87-21342
STEERABLE ANTENNAS
Studies of millimeter-wave diffraction devices and materials. Phase 3
[AD-A176917] N87-21244
STELLAR ENVELOPES
Using nonradial pulsations to determine the envelope composition of very evolved stars
[DE87-001982] N87-21765
On the mass loss rate by the nuclei of planetary nebulae
[DE87-701325] N87-21777
STELLAR EVOLUTION
Using nonradial pulsations to determine the envelope composition of very evolved stars
[DE87-001982] N87-21765
Dynamical evolution of spherical stellar systems N87-21767
STELLAR MAGNITUDE
Shock acceleration of electrons and ions in solar flares N87-21823
STELLAR MASS
On the mass loss rate by the nuclei of planetary nebulae
[DE87-701325] N87-21777
STELLAR WINDS
On the mass loss rate by the nuclei of planetary nebulae
[DE87-701325] N87-21777
STEREOSCOPIC VISION
Contribution to the implementation of dynamic vision in the three-dimensional perception system of the HILARE robot
[CNRS-ORDER-959] N87-21357
STIFFENING
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
STIFFNESS
The effects of curvature on the stiffness of laterally loaded rectangular plates
[NPL-DMA(A)-122] N87-21370
STIRLING ENGINES
A 1987 overview of free-piston Stirling technology for space power application
[NASA-TM-89832] N87-21756
STOCHASTIC PROCESSES
FY86 independent research/independent exploratory development
[AD-A176944] N87-21589
The abandoned ways: Turbulence and chaos
[NOTA-INTERNA-869] N87-21732
STOCKPILING
Superalloy resources: Supply and availability
[NASA-TM-89866] N87-21077
STORAGE RINGS (PARTICLE ACCELERATORS)
SC correction coils and magnets for the HERA proton ring
[NIKHEF-H/86-10] N87-21676
The acceptance of the SSC (Superconducting Supercollider) clustered lattice
[DE87-004177] N87-21697
STORAGE STABILITY
The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement N87-21147
STORAGE TANKS
Advanced long term cryogenic storage systems N87-21142
Shuttle middeck fluid transfer experiment: Lessons learned N87-21158
Approach to evaluating leak detection methods in underground storage tanks
[PB87-118444] N87-21168
STRAIN ENERGY METHODS
Fracture and hardness of semiconductor alloys
[AD-A176800] N87-21088
STRAIN ENERGY RELEASE RATE
Convergence of strain energy release rate components for edge-delaminated composite laminates
[NASA-TM-89135] N87-21377
STRAIN HARDENING
Ductile fracture and random versus regular hole/void arrays
[AD-A176627] N87-21085
Stage 4 work hardening in cubic metals
[DE87-003756] N87-21094
Strain and stress cycling in elastic-plastic materials N87-21372
STRAIN MEASUREMENT
General finite strain tensors
[DE87-003807] N87-21391
STRAIN RATE
Processing and properties of powder metallurgy Ni(sub 3)Al-Cr-Zr-B for use in oxidizing environments
[DE87-001699] N87-21101
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384
STRANGE ATTRACTORS
The multifractal nature of strange attractors and turbulence
[PREPRINT-539] N87-21640
STRATEGIC MATERIALS
Superalloy resources: Supply and availability
[NASA-TM-89866] N87-21077
STRATIFICATION
Mixing in a double-diffusive, partially stratified fluid
[DE87-001131] N87-21285
STRATOSPHERE
Retrievals of lower stratospheric ozone profiles from Nimbus-4 and their use in a synoptic-climatological study N87-21423
Three dimensional dynamical and chemical modelling of the upper atmosphere
[NASA-CR-180514] N87-21428
Validation of SAM 2 and SAGE satellite
[NASA-CR-178256] N87-21429
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere
[DE87-003600] N87-21438
STREAK PHOTOGRAPHY
LLE review
[DE87-005865] N87-21324
STRESS (PHYSIOLOGY)
Sleep deprivation and exercise tolerance
[AD-A176171] N87-21555
Reaction of sympathectomied rat opioid system to immobilization stress N87-21581
STRESS ANALYSIS
Investigation and design of a high efficiency turbine wheel
[AD-A176191] N87-20997
Multi-axial failure criteria in fiber composites and their application to the through-thickness strength of hybrid fiber laminates N87-21040
Titanium-beryllium residual strain analysis: Role of deposition variables on texture and strength
[DE87-006197] N87-21108
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378
Full-field stress-strain analysis of cracking plates
[AD-A176986] N87-21383
Finite element analysis of three-dimensional structures using adaptive p-extensions
[FFA-TN-1986-57] N87-21401
Stress and efficiency studies in EFG
[NASA-CR-180527] N87-21412
Large area sheet task: Advanced dendritic web growth development
[NASA-CR-180505] N87-21417
STRESS CONCENTRATION
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378
Elastic interactions of a crack with damage and associated energy release rates
[AD-A177071] N87-21385
STRESS CORROSION
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
STRESS CORROSION CRACKING
Stress corrosion cracking and metal-induced embrittlement: Comparative studies of local chemistries
[DE87-004300] N87-21097
Grain boundary composition effects on environmentally induced cracking of engineering materials
[DE87-006405] N87-21105
STRESS INTENSITY FACTORS
Elastic interactions of a crack with damage and associated energy release rates
[AD-A177071] N87-21385
STRESS MEASUREMENT
Acoustic radiation stress measurement
[NASA-CASE-LAR-13440-1] N87-21653
STRESS RATIO
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387
STRESS RELAXATION
Stress release in ion implanted lattice mismatched semiconductor heterostructures
[DE87-004518] N87-21703
STRESS TENSORS
General finite strain tensors
[DE87-003807] N87-21391
STRESS-STRAIN RELATIONSHIPS
Strain and stress cycling in elastic-plastic materials N87-21372
Full-field stress-strain analysis of cracking plates
[AD-A176986] N87-21383
STRESSES
Resistance curve approach to predicting residual strength of composites
[AD-A176984] N87-21050
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21362
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384
The comet Giacobini-Zinner magnetotail: Axial stresses and inferred near-nucleus properties
[DE87-003712] N87-21775
STRING THEORY
The d=2 conformal gauge theory
[NIKHEF-H/86-13] N87-21727
Gauge fixing for the field theory of the bosonic string
[PREPRINT-527] N87-21729
Hadron phenomenology via the fire-string model
[PREPRINT-533] N87-21731
STRUCTURAL ANALYSIS
OPUS: Optimal Projection for Uncertain Systems
[AD-A176820] N87-21025
Analysis of plasma-nitrided steels
[NASA-TM-89815] N87-21078
Failure strengths of laminated glass units
[PB87-118873] N87-21113
Activities report in structures
[ETN-87-99375] N87-21166
Wavevector-frequency spectrum of transition zone wall pressure fluctuations
[AD-A176655] N87-21266
Activities report in fluid mechanics
[ETN-87-99370] N87-21268
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
Modeling and control of flexible structures
[AD-A177106] N87-21388
Penalization study of a variational inequalities system used to model a cylindrical shell with symmetric loading
[ECL-86-08] N87-21397
Self-adaptive Finite Element (FE) analysis of solid structures. Part 1: Element formulation and a posteriori error estimation
[FFA-TN-1986-27] N87-21400
Finite element analysis of three-dimensional structures using adaptive p-extensions
[FFA-TN-1986-57] N87-21401
Fluctuations in membranes with crystalline and hexatic order
[PREPRINT-538] N87-21402
STRUCTURAL DESIGN
Development of optimization system OPTSYS: Implementation of static aeroelastic constraints
[FFA-TN-1986-40] N87-20994
Block 2 SRM conceptual design studies. Volume 1, Book 1: Conceptual design package
[NASA-CR-179048] N87-21034
Block 2 SRM conceptual design studies. Volume 1, Book 1: Appendix A: CEI specification CPW1-1900, Appendix B: Composite motor case
[NASA-CR-179049] N87-21035
Block 2 SRM conceptual design studies. Volume 1, Book 2: Preliminary development and verification plan
[NASA-CR-179054] N87-21036
STRUCTURAL DESIGN CRITERIA
The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary
[NASA-CR-178276] N87-21020
Study of an optimum design problem with frequency criteria applied to a structure-fluid coupled system
[ECL-86-05] N87-21396
High efficiency crystalline silicon solar cells
[NASA-CR-180530] N87-21411

STRUCTURAL STABILITY
Wing divergence and structural distortion
[RAE-TR-85057] N87-20989
STRUCTURAL STRAIN
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378
Finite element analysis of three-dimensional structures using adaptive p-extensions
[FFA-TN-1986-57] N87-21401
STRUCTURAL VIBRATION
Acquisition and analysis of dynamic rotating machinery data N87-21190
Summary of the modeling and test correlations of a NASTRAN finite element vibrations model for the AH-1G helicopter, task 1
[NASA-CR-178201] N87-21373
Stabilization and control problems in structural dynamics
[AD-A177183] N87-21389
Identification of material constants for a composite shell structure
[DE87-004524] N87-21395
STUDENTS
Hover performance of a remotely piloted helicopter
[AD-A176587] N87-20992
School and the nuclear energy problems: Preliminary analysis of a questionnaire
[NOTA-INTERNA-873] N87-21678
STYRENES
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: An initial study
[NASA-TM-89846] N87-21043
SUBMILLIMETER WAVES
Astronomical observations of the 807 GHz CO J = 7-6 rotational line with a new heterodyne spectrometer N87-21759
SUBROUTINES
STARPAC: The standard times series and regression package
[PB87-152385] N87-21641
SUBSONIC SPEED
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264
SUBSTRATES
Vectorial electron transfer on designed surfaces
[PB87-144325] N87-21137
Application of the ALE and MBE methods to the growth of layered Hg sub 1-x Cd sub x Te films
[AD-A176797] N87-21692
SULFONES
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: An initial study
[NASA-TM-89846] N87-21043
SULFUR COMPOUNDS
Spectral reflectance (0.4 - 5.0 microns) of sulfur related compounds and mixtures
[NASA-CR-180525] N87-21781
SUPERCOMPUTERS
Algorithm implementation on the Navier-Stokes computer
[NASA-TM-89119] N87-20968
An agenda for improved evaluation of supercomputer performance
[DE87-005698] N87-21593
Hypercube Applications at Oak Ridge National Laboratory
[DE87-005691] N87-21594
Agenda for improved evaluation of supercomputer performance
[PB87-137196] N87-21596
Intelligent operating systems for autonomous robots: Real-time capabilities on a hypercube super-computer
[DE87-004076] N87-21620
SUPERCONDUCTING MAGNETS
Determination of the linear aperture of the SSC (Superconducting Supercollider) clustered lattice used for the conceptual design report
[DE87-004179] N87-21696
SUPERCONDUCTIVITY
Basic ideas in the theory of organic conductors
[DE87-003209] N87-21699
Nature of coupling and dimensional crossover in superconducting multilayers
[DE87-004676] N87-21706
Superconducting properties of compositionally modulated Pb/Ge thin films
[DE87-004679] N87-21708
The effect of ion damage and annealing on superconducting transition metal-nitride compounds
[DE87-005988] N87-21712
SUPERCONDUCTORS
Research on cryogenic vacuum tunneling
[AD-A176363] N87-21082
Superlattice effects in graphite intercalation compounds
[AD-A177009] N87-21119
Vortices in long Josephson junctions
[AD-A176916] N87-21695
The acceptance of the SSC (Superconducting Supercollider) clustered lattice
[DE87-004177] N87-21697
Basic ideas in the theory of organic conductors
[DE87-003209] N87-21699
Nature of coupling and dimensional crossover in superconducting multilayers
[DE87-004676] N87-21706
Artificially structured superconductors
[DE87-004007] N87-21714
Electromechanical properties of superconductors for high-energy physics applications
[DE87-006048] N87-21715
Technical publication announcements covering Center programs, January to March 1986
[PB87-140273] N87-21748
SUPERCOOLING
Viscosity behavior in supercooled pure liquids and mixtures
[DE87-004036] N87-21282
SUPERCRITICAL FLUIDS
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE87-004004] N87-21065
SUPERFLUIDITY
Research on thermophysical properties of materials
[DE87-005682] N87-21064
Superfluid helium on orbit transfer (SHOOT) N87-21151
Convectively driven superfluid turbulence in dilute solutions of He3 in superfluid He4
[DE87-002918] N87-21275
SUPERGRAVITY
Multiplet calculus and compensating fields in D = 2 conformal supergravity
[NIKHEF-H/86-11] N87-21726
Residual supersymmetry of compactified d=10 supergravity
[NIKHEF-H/86-15] N87-21728
SUPERLATTICES
Effect of aluminum addition on ductility and yield strength of Fe3Al alloys with 0.5 wt % TiB2
[DE87-004621] N87-21098
The 2-4 semiconductor superlattices
[AD-A177092] N87-21696
Investigations on the MBE growth and properties of Al/(y)/Ga/(y)/In/(1-x-y/As/InP) and InAlAs superlattices
[DE87-005190] N87-21709
MBE (Molecular Beam Epitaxy) growth of strained-layer superlattice device structures
[DE87-005681] N87-21711
SUPERNOVAE
Theoretical and observational review of results on nova explosions occurring on ONeMg white dwarfs
[DE87-001962] N87-21772
White dwarf models of supernovae and cataclysmic variables
[DE87-004172] N87-21773
SUPERPRESSURE BALLOONS
LORAN-C tetroon transponder and tracking system
[PB87-116887] N87-20987
SUPERSYMMETRY
Supermultiplets in Hilbert space for the supersymmetric bag model
[NIKHEF-H/86-5] N87-21664
Residual supersymmetry of compactified d=10 supergravity
[NIKHEF-H/86-15] N87-21728
SURFACE COOLING
Picosecond laser pulse interactions with metallic and semiconductor surfaces
[AD-A176645] N87-21087
SURFACE CRACKS
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382
SURFACE DISTORTION
Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna
[NASA-TM-89137] N87-21021
SURFACE FINISHING
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387
SURFACE LAYERS
Pulsations of white dwarf stars with thick hydrogen or helium surface layers
[DE87-001954] N87-21774
SURFACE PROPERTIES
Development of chemical sensors: Empirical art or systematic research?
[DRIC-T-7783] N87-21059
Research on cryogenic vacuum tunneling
[AD-A176363] N87-21082
Ion beam sputter etching
[NASA-CASE-LEW-13899-1] N87-21160
Wear induced by small amplitude vibrations: Phenomena identification
[ECL-86-11] N87-21359
Pulsations of white dwarf stars with thick hydrogen or helium surface layers
[DE87-001954] N87-21774
SURFACE REACTIONS
Development of chemical sensors: Empirical art or systematic research?
[DRIC-T-7783] N87-21059
Layered target burnthrough experiments using 50 nsec KrF laser pulses
[DE87-005111] N87-21329
Computer modeling of high intensity solar cells
[DE87-005970] N87-21416
SURFACE ROUGHNESS
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387
Characteristics of the two-dimensional spectrum of roughness on a seamount
[AD-A176366] N87-21538
Versatile three-dimensional Hamiltonian ray-tracing program for acoustic waves in the atmosphere above irregular terrain
[PB87-115804] N87-21659
SURFACE VEHICLES
Personnel emergency carrier vehicle
[NASA-CASE-KSC-11282-1] N87-21755
SURFACE WAVES
Scattering of surface waves by nonuniform waveguides
[AD-A176632] N87-21219
SURFACTANTS
Inhibition of localized corrosion
[AD-A176573] N87-21083
SURGERY
Reaction of sympathectomied rat opioid system to immobilization stress N87-21581
SURVEILLANCE
Task execution control in assembly robot workcells
[LAAS-86-335] N87-21356
SURVEYS
Chesapeake Bay circulation survey: 1981-1983
[PB87-138194] N87-21549
SURVIVAL
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
SWEDEN
Spread F: The Scandinavian scene
[UIO-SR-86-02] N87-21443
SWEPT FORWARD WINGS
Divergence and flutter of swept-forward wings with crossflexibilities
[RAE-TR-80047] N87-21000
SWEPT WINGS
Aileron reversal of swept wings with crossflexibilities
[RAE-TR-83023] N87-20988
SWITCHES
Graphite as a picosecond laser activated opening switch
[DE87-003758] N87-21251
SWITCHING
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year-1
[AD-A176639] N87-21681
SWITCHING CIRCUITS
Four quadrant control circuit for a brushless three-phase dc motor
[NASA-CASE-MFS-28080-1] N87-21233
A solid state triggered switch for EBW firing circuits — exploding bridge wire (EBW)
[RARDE-MEMO-6/86] N87-21236
SYMBOLS
The binary weight distribution of the extended (2 sup m, 2 sup m-4) code of Reed-Solomon code over GF(2 sup m) with generator polynomial (x-alpha sup 2) (x-alpha sup 3)
[NASA-CR-180510] N87-21625

SYMMETRY
Inflation in spherically symmetric inhomogeneous models
[DE87-005405] N87-21779
SYMPATHETIC NERVOUS SYSTEM
Reactivity of adrenosympathetic system and tolerance to exercise load during repeated exposure to stationary magnetic field N87-21573
Reaction of sympathectomied rat opioid system to immobilization stress N87-21581
SYNCHRONOUS SATELLITES
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 1: Executive summary
[NASA-CR-179597-VOL-1] N87-21212
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 2: Technical report
[NASA-CR-179597-VOL-2] N87-21213
Improvements in geostationary satellite wind observations as a result of the Global Weather Experiment and applications of these in the context of the World Weather Watch (WWW) system N87-21476
SYNCHROTRON RADIATION
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces
[AD-A176445] N87-21691
The possible importance of synchrotron/inverse Compton losses to explain fast mm-wave and hard X-ray emission of a solar event N87-21802
SYNOPTIC MEASUREMENT
Retrievals of lower stratospheric ozone profiles from Nimbus-4 and their use in a synoptic-climatological study N87-21423
Snow depths in the Netherlands from measurements at synoptic stations in 1955 and in the period 1978-1984
[KNMI-TR-51A] N87-21522
White light solar corona: An atlas of 1985 K-coronameter synoptic charts, December 1984 - December 1985
[PB87-138095] N87-21837
SYNOPTIC METEOROLOGY
On the synoptics and dynamics of orographically induced cyclones in the Mediterranean N87-21506
Nonalpine contribution to Mediterranean cyclogenesis: Synoptic study of two cases which occurred during Alpine Experiment (ALPEX) Special Observing Period N87-21510
Synoptic 3D energy budgets during Alpine Experiment Special Observing Period (ALPEX-SOP) N87-21511
SYNTHESIS (CHEMISTRY)
Lead titanates: Electromechanical anisotropic materials applicable to electroacoustic instrumentation
[INSA-IDI1-8603] N87-21068
Process for preparing phthalocyanine polymer from imide containing bisphthalonitrile
[NASA-CASE-ARC-11511-2] N87-21112
Ordered polymers for space applications
[AD-A177108] N87-21120
SYNTHETIC APERTURE RADAR
Testing of the advanced microwave instrument for the European Remote Sensing Satellite ERS-1
[ETN-87-99477] N87-21409
SYSTEMS ANALYSIS
Fault-tolerant system analysis: Imperfect switching and maintenance
[AD-A176514] N87-20995
Orbital transfer vehicle concept definition and system analysis study. Volume 1A: Executive summary. Phase 2
[NASA-CR-179055] N87-21018
Papers presented at a Workshop on Electric Energy Systems Research
[PB87-137238] N87-21254
Manipulator Comparative Testing Program
[DE87-006026] N87-21355
Agenda for improved evaluation of supercomputer performance
[PB87-137196] N87-21596
SYSTEMS COMPATIBILITY
Acquisition and processing of non-stationary pressure measurments in studies of air intake distortion N87-21191
SYSTEMS ENGINEERING
Activities report in systems
[ETN-87-99371] N87-20962
A drift chamber with variable drift velocity
[NIKHEF-H/86-12] N87-21310
Programmers workbench handbook
[PB87-126942] N87-21611
SYSTEMS MANAGEMENT
Activities report in systems
[ETN-87-99371] N87-20962

T

TABLES (DATA)
Haze climate of the United States
[PB87-141057] N87-21529
TAPERING
The effects of impact damage in tapered-thickness CFRP laminates
[RAE-TR-85087] N87-21045
TARGET RECOGNITION
Activities report of the Department of Reconnaissance and Seeker Systems
[FOA-C-30433-3.1/3.2/3.3/3.4] N87-21227
TARGETS
Layered target burnthrough experiments using 50 nsec KrF laser pulses
[DE87-005111] N87-21329
TAYLOR INSTABILITY
Development of a two-equation turbulent mix model
[DE87-005837] N87-21284
TEA LASERS
Laser evaporation studies
[AD-A176826] N87-21313
TECHNICAL WRITING
Document preparation guide
[DE86-015942] N87-21738
TECHNOLOGICAL FORECASTING
New structural materials technologies: Opportunities for the use of advanced ceramics and composites
[PB87-118253] N87-21128
TECHNOLOGY ASSESSMENT
Block 2 SRM conceptual design studies. Volume 1, Book 1: Conceptual design package
[NASA-CR-179048] N87-21034
Energetic materials for military purposes: An assessment
[PB87-137220] N87-21138
Cryogenic Fluid Management Flight Experiment (CFMFE) N87-21150
Field assisted etching
[RSRE-MEMO-3715] N87-21161
Methods for thinning silicon chips
[RSRE-MEMO-3952] N87-21162
Biological materials for integrated circuits
[RSRE-MEMO-3965] N87-21237
Investigation into the characteristics of ZnSe filters
[RSRE-MEMO-3993] N87-21680
Improving the transfer and use of scientific and technical information: The federal role. Volume 2: Problems and issues in the transfer and use of STI
[PB87-142923] N87-21747
TECHNOLOGY TRANSFER
Improving the transfer and use of scientific and technical information: The Federal role. Volume 1: Summary and conclusions
[PB87-142915] N87-21746
Improving the transfer and use of scientific and technical information: The federal role. Volume 2: Problems and issues in the transfer and use of STI
[PB87-142923] N87-21747
Advanced sensors, telecommunications and data processing: Technological spin-offs from the Strategic Defense Initiative
[DE87-003884] N87-21757
TECHNOLOGY UTILIZATION
Typical and historical aspects of motor gliders as meteorological measuring aircraft N87-21455
Induction linear accelerator technology for SDIO applications
[DE87-003251] N87-21642
TELECOMMUNICATION
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms
[AD-A176218] N87-20983
Fault-tolerant system analysis: Imperfect switching and maintenance
[AD-A176514] N87-20995
Satellites and developing countries: Purpose, problems, and progress
[AD-A176536] N87-21022
Communications using channels formed by meteor bursts
[AD-A176994] N87-21222
Calculation of power-flux density levels in the 2 GHz band, phase three
[PB87-120523] N87-21230
Advanced sensors, telecommunications and data processing: Technological spin-offs from the Strategic Defense Initiative
[DE87-003884] N87-21757
TELEOPERATORS
Development of a telerobotic system for handling contaminated process equipment
[DE87-004186] N87-21346
TELEPHONY
Communication systems through artificial Earth satellites (selected pages)
[AD-A176940] N87-21028
TELEVISION SYSTEMS
Activities report in electrical technology
[ETN-87-99354] N87-21253
TELEVISION TRANSMISSION
Communication systems through artificial Earth satellites (selected pages)
[AD-A176940] N87-21028
TEMPERATURE
Monthly and Seasonal Weather Outlook for November 1986, Volume 40, Number 21, October 30, 1986
[PB87-118960] N87-21451
TEMPERATURE DEPENDENCE
Journal of Research of the National Bureau of Standards, Volume 91, Number 6, November-December 1986
[PB87-137154] N87-21650
TEMPERATURE DISTRIBUTION
Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna
[NASA-TM-89137] N87-21021
Battery thermal modeling: The methodology and applications
[DE87-004665] N87-21249
TEMPERATURE EFFECTS
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination
[ETN-87-99577] N87-21057
Kinetics of some gas phase elementary reactions of boron monofluoride
[AD-A167690] N87-21062
Fracture properties of ferritic, ferritic-pearlitic, pearlitic and bainitic nodular cast irons
[VTT-430] N87-21110
Method for forming hermetic seals
[NASA-CASE-NPO-16423-1-CU] N87-21334
Thermomechanical effects in inelastic materials and structures
[AD-A177076] N87-21388
Spectral reflectance (0.4 - 5.0 microns) of sulfur related compounds and mixtures
[NASA-CR-180525] N87-21781
TEMPERATURE GRADIENTS
Sapphire fiber optic temperature probe N87-21186
TEMPERATURE INVERSIONS
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519
TEMPERATURE MEASUREMENT
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
Simultaneous temperature measurements with Raman and CARS in laminar flames N87-21171
CARS thermometry for low and high pressure combustion systems N87-21172
Nonlinearity and single shot noise problems in CARS spectroscopy N87-21174
Application of CARS thermometry to a turbulent flame N87-21175
Velocity and temperature measurements in a can-type gas-turbine combustor N87-21184
Some considerations relating to aero engine pyrometry N87-21187
Turbine rotor blade measurements using infrared pyrometry N87-21188
Accuracy of temperature fields and local data sets for the Tatra mountains (Poland) N87-21492
TEMPERATURE PROBES
Sapphire fiber optic temperature probe N87-21186
TEMPERATURE PROFILES
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
Tethered balloon measurements made at Naval Air Development Center (December 1985)
[AD-A176254] N87-21517
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539
TEMPERATURE SENSORS
Sapphire fiber optic temperature probe N87-21186
Some considerations relating to aero engine pyrometry N87-21187
The utilization of thin film sensors for measurements in turbomachinery N87-21195
TEMPERING
Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels
[DE87-004000] N87-21092

TEMPORAL DISTRIBUTION
The microwave spectrum of solar millisecond spikes N87-21806
TEMPORAL RESOLUTION
Hard X-ray delays N87-21796
Solar microwave millisecond spike at 2.84 GHz N87-21809
TENSILE PROPERTIES
Effect of manufacturing processes on structural allowables [AD-A176232] N87-21080
Ductile fracture and random versus regular hole/void arrays [AD-A176627] N87-21085
Effect of aluminum addition on ductility and yield strength of Fe3Al alloys with 0.5 wt % TiB2 [DE87-004821] N87-21096
Processing and properties of powder metallurgy Ni(sub 3)Al-Cr-Zr-B for use in oxidizing environments [DE87-001699] N87-21101
Inertia friction welding of 1100 aluminum to type 316 stainless steel [DE87-005044] N87-21347
TENSILE STRENGTH
Design of low carbon dual-phase steels for high strength wire [DE87-006169] N87-21104
On the correlation of hardness with tensile and yield strength [VTT-416] N87-21109
Ultimate tensile strength of pitch-based carbon fibers [AD-A176955] N87-21118
TENSOR ANALYSIS
General finite strain tensors [DE87-003807] N87-21391
TERRAIN
Vorticity budgets for Alpine cyclogenesis with and without the forcing of terrain N87-21508
Effects of terrain height and blocking initialization on numerical simulation of Alpine lee cyclogenesis N87-21515
TERRAIN ANALYSIS
Versatile three-dimensional Hamiltonian ray-tracing program for acoustic waves in the atmosphere above irregular terrain [PB87-115804] N87-21659
TERRAIN FOLLOWING AIRCRAFT
Rotary-wing aircraft terrain-following/terrain-avoidance system development [NASA-TM-88323] N87-20982
TEST FACILITIES
Experimental results from railgun firings involving magnetic flux probes [MRL-TN-509] N87-21008
Alternative flow control nozzles/energy dissipation of highly erosive fluids [DE87-001025] N87-21273
Application of a high-precision universal measuring machine in Standards Laboratory measurements [DE87-003036] N87-21308
TETHERED BALLOONS
Tethered balloon measurements made at Naval Air Development Center (December 1985) [AD-A176254] N87-21517
TEXTURES
Titanium-beryllium residual strain analysis: Role of deposition variables on texture and strength [DE87-006197] N87-21106
THEORETICAL PHYSICS
Status of the electroweak theory [PREPRINT-529] N87-21670
Theoretical summary — p pbar [PREPRINT-532] N87-21730
THERMAL ANALYSIS
Measurement of fatigue crack growth kinetics of Copper-Kapton laminates by dynamic mechanical thermal analysis [DE87-003024] N87-21390
Large area sheet task: Advanced dendritic web growth development [NASA-CR-180505] N87-21417
THERMAL CONDUCTIVITY
The utilization of thin film sensors for measurements in turbomachinery N87-21195
Interpretation of rapid rises in hard X-rays and microwaves with the thermal conduction front model N87-21788
Plasma turbulence and impulsive UV line emission in solar flares N87-21818
Thermal waves or beam heating in the 1980, November 5 flare N87-21828
THERMAL EXPANSION
Journal of Research of the National Bureau of Standards, Volume 91, Number 6, November-December 1986 [PB87-137154] N87-21650
THERMAL FATIGUE
Dynamic recrystallization during high temperature low cycle fatigue of nickel [DE87-006152] N87-21103
Measurement of fatigue crack growth kinetics of Copper-Kapton laminates by dynamic mechanical thermal analysis [DE87-003024] N87-21390
THERMAL INSULATION
Modeling the convection-radiation coupling in porous materials and identification of their radiation characteristics: Application to glass wools [INSA-86-ISAL-0007] N87-21290
THERMAL PLASMAS
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176615] N87-21024
Millimeter wave generation by relativistic electron beams [AD-A176949] N87-21245
Nonequilibrium in flowing atmospheric plasmas [ETN-87-99587] N87-21688
THERMAL PROTECTION
Performance analysis of advanced spacecraft TPS [NASA-CR-180496] N87-21011
THERMIONICS
Supercritical fluid chromatography of polar organic compounds in combustion particulates [PB87-128645] N87-21073
THERMOCLINES
The Gulf Stream dynamics experiment: Inverted echo sounder data report for the July 1982 to April 1983 deployment period [AD-A176776] N87-21543
THERMOCOUPLES
Processing techniques for correlation of LDA and thermocouple signals N87-21194
THERMODYNAMIC EFFICIENCY
Modeling the convection-radiation coupling in porous materials and identification of their radiation characteristics: Application to glass wools [INSA-86-ISAL-0007] N87-21290
THERMODYNAMIC EQUILIBRIUM
Derivation of working equations of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte with consideration of extracted oxygen N87-21575
Calculation of equilibrated concentrations of constituents of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte and corresponding values of theoretical voltage of dissociation N87-21576
THERMODYNAMIC PROPERTIES
Communication systems through artificial Earth satellites (selected pages) [AD-A176940] N87-21028
State equation of condensed materials: Physical principles and applications [ECL-86-15] N87-21069
Cluster beam studies [AD-A176803] N87-21163
Full-field stress-strain analysis of cracking plates [AD-A176986] N87-21383
Multispectral analysis of a tropical radience set from the TIROS operational vertical sounder [AD-A176578] N87-21432
Kinetics and thermodynamics of quasicrystals as determined by surface modification techniques [DE87-005538] N87-21713
THERMODYNAMICS
Thermomechanical effects in inelastic materials and structures [AD-A177076] N87-21386
THERMOGRAPHY
Digital image processing applied to fluid dynamic problems N87-21193
THERMOPHYSICAL PROPERTIES
Research on thermophysical properties of materials [DE87-005682] N87-21064
THERMOSETTING RESINS
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: An initial study [NASA-TM-89846] N87-21043
THICKNESS
Fracture properties of ferritic, ferritic-pearlitic, pearlitic and bainitic nodular cast irons [VTT-430] N87-21110
THIN FILMS
Investigations into the origins of the physical structure of thin films [AD-A176943] N87-21117
Vectorial electron transfer on designed surfaces [PB87-144325] N87-21137
Cluster beam studies [AD-A176803] N87-21163
The utilization of thin film sensors for measurements in turbomachinery N87-21195
Traveling-wave-tube efficiency improvement by a low-cost technique for deposition of carbon on multistage depressed collector [NASA-TP-2719] N87-21239
Laser evaporation studies [AD-A176626] N87-21313
Superconducting properties of compositionally modulated Pb/Ge thin films [DE87-004679] N87-21706
The effect of ion damage and annealing on superconducting transition metal-nitride compounds [DE87-005988] N87-21712
THREE DIMENSIONAL FLOW
Experimental studies on the dynamic development and control of unsteady separated flows [AD-A176376] N87-20969
An approach to practical aerodynamic calculations [AD-A176995] N87-20970
Solution of the three-dimensional Navier-Stokes equations for a turbulent horseshoe vortex flow [AD-A176370] N87-21263
Numerical study of three-dimensional laminar and turbulent flows with system rotation [AD-A176546] N87-21264
THREE DIMENSIONAL MOTION
Versatile three-dimensional Hamiltonian ray-tracing program for acoustic waves in the atmosphere above irregular terrain [PB87-115804] N87-21659
THRESHOLD CURRENTS
Comparison between calculated and measured forward and reverse current-voltage characteristics [AD-A176607] N87-21241
THRUST AUGMENTATION
Flow induction by rotary jets [AD-A177013] N87-21270
THUNDERSTORMS
Convective scale interaction: Arc cloud lines and the development and evolution of deep convection N87-21424
Thunderstorm influence on boundary layer winds [AD-A176543] N87-21518
Verification of severe local storm forecasts issued by the National Severe Storms Forecast Center, 1985 [PB87-137139] N87-21527
Severe local storm warning verification: 1985 [PB87-137147] N87-21528
TIME
Accuracy of time transfer in satellite systems [AD-A176579] N87-20984
TIME DEPENDENCE
Viscosity behavior in supercooled pure liquids and mixtures [DE87-004036] N87-21282
Time-dependent simulation of small-scale turbulent mixing and reaction [PB87-140257] N87-21302
TIME DIVISION MULTIPLEXING
The fundamentals of timing and synchronization for digital communication networks [AD-A176721] N87-21220
TIME LAG
Persistent time intervals between features in solar flare hard X-ray emission N87-21790
Microwave and hard X-ray emissions during the impulsive phase of solar flares: Nonthermal electron spectrum and time delay N87-21794
Hard X-ray delays N87-21796
Relation between solar narrow-band decimeter wave bursts and associated X-ray bursts N87-21799
TIME MEASUREMENT
Synchronization tracking in pulse position modulation receiver [NASA-CASE-NPO-16256-1] N87-21207
The fundamentals of timing and synchronization for digital communication networks [AD-A176721] N87-21220
A study of starting time in great hard X-ray flares N87-21792
Rapid spectral and flux time variations in a solar burst observed at various cm-mm wavelengths and at hard X-rays N87-21803
TIME SERIES ANALYSIS
Partioning of the vertical turbulent energy transport into positive and negative contributions N87-21462
The Gulf Stream dynamics experiment: Inverted echo sounder data report for the July 1982 to April 1983 deployment period [AD-A176776] N87-21543
Multivariate analysis and its applications [AD-A177019] N87-21637
Hard X-ray imaging observation of fluctuating bursts N87-21795

Fast fluctuations of soft X-rays from active regions N87-21797
Temporal frequency of radio emissions for the April 25, 1984 flare N87-21808
A search for fast variations in the Fe XXI emission during solar flares N87-21811

TITANIUM
Densification of titanium powder during hot isostatic pressing
[AD-A176617] N87-21084
Mechanical properties of elementally blended Ti-6Al-4V
[AD-A176640] N87-21086
Titanium-beryllium residual strain analysis: Role of deposition variables on texture and strength
[DE87-006197] N87-21106

TITANIUM ALLOYS
Net shape technology in aerospace structures. Volume 2. Appendix. Precision Forgings in Aerospace Structures. Presentations of a workshop held on December 3-5, 1984 in Oxnard, California
[AD-A176509] N87-20958
Net shape technology in aerospace structures. Volume 3. Appendix. Emerging Net Shape Technologies. Presentations of a workshop held on March 27-29, 1985 in Santa Barbara, California
[AD-A176510] N87-20959
Plasma joining of metal matrix composites
[AD-A176690] N87-21042
Electromechanical properties of superconductors for high-energy physics applications
[DE87-006048] N87-21715

TITANIUM OXIDES
Vectorial electron transfer on designed surfaces
[PB87-144325] N87-21137

TOLERANCES (PHYSIOLOGY)
Sleep deprivation and exercise tolerance
[AD-A176171] N87-21555

TOMOGRAPHY
Digital image processing applied to fluid dynamic problems N87-21193

TOOLS
Programmers workbench handbook
[PB87-126942] N87-21611

TOPOGRAPHY
A numerical investigation of an orogenic mesoscale convective system N87-21425
A theory of deep cyclogenesis in the lee of the Alps: Modification of baroclinic instability by topography N87-21499
Noctural topoclimatology
[WCP-117] N87-21520
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
Characteristics of the two-dimensional spectrum of roughness on a seamount
[AD-A176366] N87-21538

TORNADOES
Verification of severe local storm forecasts issued by the National Severe Storms Forecast Center, 1985
[PB87-137139] N87-21527
Severe local storm warning verification: 1985
[PB87-137147] N87-21528

TOWERS
A prediction method for the air-droplets flow in the inlet section of a natural draft cooling tower
[VKI-TM-40] N87-21301

TOXICITY
Comparison of the toxicity of the combustion products from a flexible polyurethane foam and a polyester fabric evaluated separately and together by the NBS (National Bureau of Standards) toxicity test method and a cone radiant heater toxicity test apparatus
[PB87-140265] N87-21169

TOXICITY AND SAFETY HAZARD
Handbook for using foams to control vapors from hazardous spills
[PB87-145660] N87-21421

TRACE CONTAMINANTS
Gravimetric technique for the preparation of accurate trace organic gas standards
[PB87-145736] N87-21074

TRACKING NETWORKS
LORAN-C tetroon transponder and tracking system
[PB87-116687] N87-20987

TRAJECTORIES
Solar wind plasma in the magnetosphere method of entry and consequences
[AD-A177255] N87-21835

TRAJECTORY CONTROL
State constraints for predictive control with air vehicle application
[AD-A176205] N87-21002

TRANSFER FUNCTIONS
Wave propagation in periodic truss structures
[AD-A176548] N87-21381

TRANSFERRING
Accuracy of time transfer in satellite systems
[AD-A176579] N87-20984

TRANSFORMATIONS (MATHEMATICS)
The Universal Transverse Mercator grid formulas for cartographic applications programmers
[AD-A176624] N87-21407
The gauge field copies and Backlund transformation
[PREPRINT-513] N87-21632
On a new Darboux transformation for the construction of exact solutions of the Schroedinger equation
[PREPRINT-523] N87-21634

TRANSISTORS
Four quadrant control circuit for a brushless three-phase dc motor
[NASA-CASE-MFS-28080-1] N87-21233

TRANSITION PRESSURE
Wavevector-frequency spectrum of transition zone wall pressure fluctuations
[AD-A176655] N87-21268

TRANSLATING
Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year-1
[AD-A176839] N87-21681

TRANSLATIONAL MOTION
Raman spectra of water in the translational and librational regions. Part 1: Study of the depolarization ratio
[PREPRINT-534] N87-21071

TRANSMISSION EFFICIENCY
Communications using channels formed by meteor bursts
[AD-A176994] N87-21222

TRANSMISSION LOSS
A numerical method for solving for normal modes with impedance bottom
[AD-A176591] N87-21540

TRANSONIC COMPRESSORS
Transonic compressor blade tip flow visualization on a water table
[AD-A176592] N87-21265

TRANSONIC FLOW
Numerical grid generations for cascades with and without solution-adaption N87-20963
The application of holography as a transonic flow diagnostic to rotating components in turbomachinery N87-21202
Beam-modulation methods in quantitative and flow-visualization holographic interferometry N87-21204
Transonic compressor blade tip flow visualization on a water table
[AD-A176592] N87-21265
Modeling the interactions shock wave/turbulent boundary layer. Comparison of model with experiment
[ECL-86-16] N87-21291
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341

TRANSONIC WIND TUNNELS
Aircraft and engine development testing
[AD-A176711] N87-20961

TRANSPONDERS
LORAN-C tetroon transponder and tracking system
[PB87-116687] N87-20987

TRANSPORT AIRCRAFT
Extended Range Twin Operations (ETOPS) --- twin engined aircraft
[CAP-513] N87-20976
Aircraft accident reports: Brief format, US civil and foreign aviation, issue number 14, 1985 accidents
[PB86-916928] N87-20980
Summary of studies to reduce wing-mounted propfan installation drag on an M = 0.8 transport
[NASA-TP-2678] N87-20990
Advanced Electromechanical Actuation System (EMAS), flight test
[AD-A176148] N87-21001

TRANSPORT PROPERTIES
Atmospheric transport and dispersion of pollutants and related meteorological studies: Program summary
[DE87-005644] N87-21418

TRANSPORT THEORY
Electrokinetic and hydrodynamic transport through porous media
[ETN-87-99581] N87-21299
GANTRAS: A system of codes for the solution of the multigroup transport equation with a rigorous treatment of anisotropic neutron scattering. Plane and spherical geometry
[KFK-4163] N87-21665

TRAPPED PARTICLES
Physics at the laser-atomic frontier
[PB87-126611] N87-21646

TRAVELING WAVE TUBES
Traveling-wave-tube efficiency improvement by a low-cost technique for deposition of carbon on multistage depressed collector
[NASA-TP-2719] N87-21239

TRAVELING WAVES
Antarctic atmospheric infrasound
[AD-A176804] N87-21434

TRIBOLOGY
European Science Notes, Volume 41, Number 2
[AD-A176116] N87-21843

TRIGGER CIRCUITS
A solid state triggered switch for EBW firing circuits --- exploding bridge wire (EBW)
[RARDE-MEMO-6/86] N87-21236

TRITIUM
Muonic X-ray laser assisted by catalyzed fusion of deuterium and tritium
[DE87-004651] N87-21327

TROPICAL METEOROLOGY
Ship-borne systems for observing wind in the tropical zone N87-21480
Diagnostic research into the tropical atmosphere and the role of tropical processes in the general circulation N87-21484

TROPICAL REGIONS
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432

TROPICAL STORMS
Diagnostic research into the tropical atmosphere and the role of tropical processes in the general circulation N87-21484

TROPOSPHERE
Antarctic atmospheric infrasound
[AD-A176804] N87-21434
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere
[DE87-003600] N87-21436

TRUSSES
Wave propagation in periodic truss structures
[AD-A176548] N87-21381

TUNABLE LASERS
The study of combustion by means of diode laser spectroscopy N87-21201

TUNING
Precision tunable resonant microwave cavity
[NASA-CASE-LEW-13935-1] N87-21234

TURBINE BLADES
Investigation and design of a high efficiency turbine wheel
[AD-A176191] N87-20997
Evaluation of L2F-measurements in unsteady turbine flow N87-21182
Some considerations relating to aero engine pyrometry N87-21187
Turbine rotor blade measurements using infrared pyrometry N87-21188
Wake interaction effects on the transition process on turbine blades
[AD-A177094] N87-21272

TURBINE ENGINES
Compressor blade clearance measurement using capacitance and phase lock techniques N87-21200

TURBINE WHEELS
Investigation and design of a high efficiency turbine wheel
[AD-A176191] N87-20997

TURBINES
Investigation and design of a high efficiency turbine wheel
[AD-A176191] N87-20997
Evaluation of L2F-measurements in unsteady turbine flow N87-21182
Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility N87-21183

TURBOCOMPRESSORS
The application of holography as a transonic flow diagnostic to rotating components in turbomachinery N87-21202
Some aspects of fan noise generation in axial compressors
[NLR-MP-85089-U] N87-21657

TURBOFAN ENGINES
Some considerations relating to aero engine pyrometry N87-21187

TURBOFANS
Some aspects of fan noise generation in axial compressors
[NLR-MP-85089-U] N87-21657

TURBOMACHINE BLADES
A study of passage flow through a cascade of turbine blades using image plane holographic interferometry N87-21203

TURBOMACHINERY
Laser fringe anemometry for aero engine components N87-21176
Laser-2 focus velocimetry N87-21177
How to select a laser velocimeter for a given application? N87-21179
Application of Doppler and transit laser anemometry in small turbomachines N87-21180
Acquisition and analysis of dynamic rotating machinery data N87-21190
The utilization of thin film sensors for measurements in turbomachinery N87-21195
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341

TURBULENCE
Turbulent premixed flame study
[DE87-006255] N87-21066
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer
[NASA-CR-4052] N87-21257
Turbulent energy generated by accelerations and shocks
[DE87-002377] N87-21274
Convectively driven superfluid turbulence in dilute solutions of He3 in superfluid He4
[DE87-002918] N87-21275
Shock wave interaction with turbulence: Pseudospectral simulations
[DE87-004357] N87-21281
The multifractal nature of strange attractors and turbulence
[PREPRINT-539] N87-21640
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655
The abandoned ways: Turbulence and chaos
[NOTA-INTERNA-869] N87-21732

TURBULENT BOUNDARY LAYER
Viscous flow around wall mounted obstacles
[ARL-AERO-PROP-REPT-172] N87-21260
Wavevector-frequency spectrum of transition zone wall pressure fluctuations
[AD-A176655] N87-21268

TURBULENT FLOW
Laser Doppler velocimeter measurements in a turbulent junction vortex N87-20964
On the modelling of non-reactive and reactive turbulent combustor flows
[NASA-CR-4041] N87-20996
Application of CARS thermometry to a turbulent flame N87-21175
Laser-2 focus velocimetry N87-21177
Processing techniques for correlation of LDA and thermocouple signals N87-21194
Computer-aided analysis of two-dimensional laminar and turbulent incompressible flows N87-21256
Toward the large-eddy simulations of compressible turbulent flows
[NASA-CR-178273] N87-21259
Solution of the three-dimensional Navier-Stokes equations for a turbulent horseshoe vortex flow
[AD-A176370] N87-21263
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264
Convectively driven superfluid turbulence in dilute solutions of He3 in superfluid He4
[DE87-002918] N87-21275
Numerical simulation of turbulent reactive flows
[ETN-87-99398] N87-21289
Modeling the interactions shock wave/turbulent boundary layer. Comparison of model with experiment
[ECL-86-16] N87-21291
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 2: Manifestations of the mechanisms related to large oriented structures in homogeneous turbulence. Part A: Experimental study. Part B: Theoretical study
[ETN-87-99395] N87-21294
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 3: Spectral manifestations of inhomogeneity due to field effects and to the presence of walls
[ETN-87-99396] N87-21295
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 4: Study of entrainment mechanisms using simulations and experimental results
[ETN-87-99397] N87-21296
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions
[NASA-CR-180272] N87-21303

TURBULENT MIXING
Development of a two-equation turbulent mix model
[DE87-005837] N87-21284
Time-dependent simulation of small-scale turbulent mixing and reaction
[PB87-140257] N87-21302
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions
[NASA-CR-180272] N87-21303

TURBULENT WAKES
The flow around a squared obstacle N87-21185

TWO DIMENSIONAL FLOW
Computer-aided analysis of two-dimensional laminar and turbulent incompressible flows N87-21256

TWO FLUID MODELS
An investigation of the closure conditions for two-fluid models of two-phase flow
[DE87-004792] N87-21287

TWO PHASE FLOW
Computer code for gas-liquid two-phase vortex motions: GLVM
[NASA-CR-180265] N87-21139
Microgravity fluid management in two-phase thermal systems N87-21152
Two-phase reduced gravity experiments for a space reactor design N87-21154
An investigation of the closure conditions for two-fluid models of two-phase flow
[DE87-004792] N87-21287

U

ULLAGE
Mixing-induced fluid destratification and ullage condensation N87-21149

ULTRAHIGH VACUUM
Pool type liquid helium cryopump
[DE87-701268] N87-21349

ULTRASONIC FLAW DETECTION
Ultrasonic detection of weld bead geometry
[DE87-000441] N87-21366

ULTRASONIC RADIATION
Acoustic radiation stress measurement
[NASA-CASE-LAR-13440-1] N87-21653

ULTRASONICS
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
Ultrasonic cure characterization of epoxy resins: Constitutive modeling
[AD-A176661] N87-21116
The improvement and evaluation of a laser interferometer for the absolute measurement of ultrasonic displacements in the frequency range up to 15 MHz — hydrophones
[NPL-AC-109] N87-21311
Ultrasonic NDE of green-state ceramic using focused through-transmission
[DE87-001494] N87-21367

ULTRAVIOLET ABSORPTION
Spectral reflectance (0.4 - 5.0 microns) of sulfur related compounds and mixtures
[NASA-CR-180525] N87-21781

ULTRAVIOLET RADIATION
The hydrogen coverage of interstellar PAHs
[NASA-TM-89340] N87-21780
The physical origins of the cosmic ultraviolet background N87-21840

ULTRAVIOLET SPECTRA
Ultraviolet observations of Jupiter and Uranus N87-21762
Comparison of solar hard X-ray and UV line and continuum bursts with high time resolution N87-21813
Plasma turbulence and impulsive UV line emission in solar flares N87-21818

UNDERGROUND STORAGE
Approach to evaluating leak detection methods in underground storage tanks
[PB87-118444] N87-21168

UNDERWATER ACOUSTICS
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms
[AD-A176218] N87-20963
Characteristics of the two-dimensional spectrum of roughness on a seamount
[AD-A176366] N87-21538
Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21546

UNDERWATER OPTICS
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535

UNITED KINGDOM
Extended Range Twin Operations (ETOPS) — twin engined aircraft
[CAP-513] N87-20978

UNITED STATES
Aircraft accident reports: Brief format, US civil and foreign aviation, issue number 14, 1985 accidents
[PB86-916926] N87-20980
Haze climate of the United States
[PB87-141057] N87-21529

UNIVERSE
Inflation in the universe, Circa 1986
[DE87-005399] N87-21778

UNIVERSITY PROGRAM
University program management information system, fiscal year 1986.
[PB87-127379] N87-21736

UNSTEADY FLOW
Experimental studies on the dynamic development and control of unsteady separated flows
[AD-A176376] N87-20969
Studies in non-linear unsteady aerodynamics
[AD-A177006] N87-20971
Evaluation of L2F-measurements in unsteady turbine flow N87-21182
Stability of the vortex motion in oscillating flow
[AD-A176629] N87-21267
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341
Pulsations of B stars: A review of observations and theories
[DE87-003717] N87-21776

UPPER ATMOSPHERE
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176662] N87-21433

URANIUM OXIDES
Behavior of UO2 and fission in sodium vapor atmosphere at temperatures up to 2800 C — reactor core disassembly
[KFK-4135] N87-21677

URANUS ATMOSPHERE
Ultraviolet observations of Jupiter and Uranus N87-21762

USER MANUALS (COMPUTER PROGRAMS)
Prediction of the aerodynamic characteristics of cruciform missiles including effects of roll angle and control deflection
[AD-A176553] N87-21010
Computer-aided analysis of two-dimensional laminar and turbulent incompressible flows N87-21256
A NASTRAN primer for the analysis of rotating flexible blades
[NASA-TM-89861] N87-21375
Information systems inventory user instruction manual
[PB87-131009] N87-21612

USER REQUIREMENTS
Guidance on software package selection
[PB87-140810] N87-21610

V

VACUUM
Research on cryogenic vacuum tunneling
[AD-A176390] N87-21662

VACUUM GAGES
Report on the calibration of two spinning-rotor gauges for the BIPM very low pressure intercomparison — Bureau International des Poids et Mesures (BIPM)
[NPL-MOM-80] N87-21305

VACUUM SYSTEMS
High-throughput continuous cryopump
[DE87-000396] N87-21343

VANADIUM ALLOYS
Mechanical properties of elementally blended Ti-6Al-4V
[AD-A176640] N87-21066
A literature review of the properties and uses of vanadium in engineering alloys and of vanadium carbide
[DE87-900462] N87-21096

VANADIUM CARBIDES
A literature review of the properties and uses of vanadium in engineering alloys and of vanadium carbide
[DE87-900462] N87-21096

VANADIUM OXIDES
High-temperature relative enthalpies of V2O5: Report of investigations/1986
[PB87-140737] N87-21733
VAPOR DEPOSITION
Titanium-beryllium residual strain analysis: Role of deposition variables on texture and strength
[DE87-006197] N87-21108
Cluster beam studies
[AD-A176803] N87-21163
Laser evaporation studies
[AD-A176826] N87-21313
VAPOR PHASES
Kinetics of some gas phase elementary reactions of boron monofluoride
[AD-A167690] N87-21062
VAPORS
Mixing-induced fluid destratification and ullage condensation N87-21149
Handbook for using foams to control vapors from hazardous spills
[PB87-145660] N87-21421
VARIABILITY
A solid propellant charge design with negative effective pressure exponent using forced cone burning
[WSRL-0469-TR] N87-21130
VARIABLE STARS
Pulsations of B stars: A review of observations and theories
[DE87-003717] N87-21776
Very high energy gamma ray astrophysics
[DE87-006293] N87-21842
VARIATIONAL PRINCIPLES
Mathematical and numerical study of a single side contact friction problem in elasticity and elastoplasticity
[ECL-85-09] N87-21358
Penalization study of a variational inequalities system used to model a cylindrical shell with symmetric loading
[ECL-86-08] N87-21397
VELOCITY DISTRIBUTION
The flow around a squared obstacle N87-21185
VELOCITY MEASUREMENT
How to select a laser velocimeter for a given application? N87-21179
Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility N87-21183
Velocity and temperature measurements in a can-type gas-turbine combustor N87-21184
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
Use of laser-Doppler-anemometry for the measurement of velocity distributions at the intake of a longitudinal flow heat exchanger
[JUEL-SPEZ-362] N87-21293
VENTILATION
Sleep deprivation and exercise tolerance
[AD-A176171] N87-21555
VENTURI TUBES
Liquid seeding atomizer
[NASA-CASE-ARC-11631-1] N87-21255
VERTICAL AIR CURRENTS
Determination of vertical air velocity using measurements of the aircraft motion N87-21456
Influencing variables in the assessment of vertical wind velocity by means of flight-mechanics equations N87-21457
Partioning of the vertical turbulent energy transport into positive and negative contributions N87-21462
Wind forcing experiments in the California current system
[AD-A176818] N87-21545
VERTICAL DISTRIBUTION
Navigational Aid (NAVAID) vertical sounding system — atmospheric sounding N87-21479
VERTICAL MOTION
Vertical air motion and turbulence parameters from commercial aircraft N87-21494
VERTICAL ORIENTATION
Retrievals of lower stratospheric ozone profiles from Nimbus-4 and their use in a synoptic-climatological study N87-21423
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176662] N87-21433
Thunderstorm influence on boundary layer winds
[AD-A176543] N87-21518
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536
VERY HIGH FREQUENCIES
VHF radio broadcasting: Propagation and diversity reception of mixed polarised signals over a sea path
[BBC-RD-1987/2] N87-21208
Macromodeling of digital circuits
[AD-A176874] N87-21243
VERY LARGE SCALE INTEGRATION
Analysis of the feasibility of silicon on insulator submicron CMOS technology
[ECL-86-07] N87-21716
VERY LONG BASE INTERFEROMETRY
Solar VLBI N87-21607
VESTIBULAR TESTS
Mathematical model of the otolith N87-21572
VIBRATION
Analysis of vibration data from WHL (Westland Helicopters Limited) Wessex fatigue test trial 3
[AD-A176208] N87-21003
Wavevector-frequency spectrum of transition zone wall pressure fluctuations
[AD-A176655] N87-21268
VIBRATION DAMPING
Modeling and control of flexible structures
[AD-A177106] N87-21388
Stabilization and control problems in structural dynamics
[AD-A177183] N87-21389
VIBRATION EFFECTS
Wear induced by small amplitude vibrations: Phenomena identification
[ECL-86-11] N87-21359
VIBRATION MEASUREMENT
Vibration analysis by speckle interferometry N87-21197
VIBRATION TESTS
Analysis of vibration data from WHL (Westland Helicopters Limited) Wessex fatigue test trial 3
[AD-A176208] N87-21003
Multi-point transient modal testing
[DE87-003880] N87-21394
VIBRATIONAL SPECTRA
A handbook of (sup)13 C NMR spectra of alkyd paint binders and associated materials — nuclear magnetic resonance (NMR)
[MQAD-TP-911] N87-21114
Modeling and control of flexible structures
[AD-A177106] N87-21388
VINYL COPOLYMERS
Network polymers formed under nonideal conditions
[AD-A176408] N87-21115
VINYL POLYMERS
Network polymers formed under nonideal conditions
[AD-A176408] N87-21115
VINYL RADICAL
Network polymers formed under nonideal conditions
[AD-A176408] N87-21115
VISCOELASTIC CYLINDERS
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262
VISCOELASTICITY
Ultrasonic cure characterization of epoxy resins: Constitutive modeling
[AD-A176661] N87-21116
Nonlinear viscoelastic analysis of adhesively bonded joints
[AD-A176494] N87-21379
VISCOPLASTICITY
La Recherche Aerospatiale, bimonthly bulletin, number 1986-2, 231/March-April
[ESA-TT-998] N87-20974
VISCOSITY
On the artificial viscosity in 1D spherical geometry
[DE87-004449] N87-21279
Viscosity behavior in supercooled pure liquids and mixtures
[DE87-004036] N87-21282
VISCOUS FLOW
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264
VISCOUS FLUIDS
Maximum principle for viscous fluids flowing through regions of pure fluid and mixtures
[DE86-760543] N87-21277
VISION
Using vision systems when bar code won't work
[DE87-004514] N87-21740
VISUAL CONTROL
Runway Visual Range (RVR) documentation of the civil airports in the Netherlands
[KNMI-TR-84] N87-20986
VISUAL FLIGHT
Runway Visual Range (RVR) documentation of the civil airports in the Netherlands
[KNMI-TR-84] N87-20986
VOICE
Comparison of the effects of broad-band noise on speech intelligibility and voice quality ratings
[AD-A176900] N87-21221
VOICE CONTROL
Multispeaker number recognition
[ENST-86E008] N87-21225
VOICE DATA PROCESSING
Multispeaker number recognition
[ENST-86E008] N87-21225
Analysis and restitution of voice signals using evolving models
[ENST-86E009] N87-21226
VOIDS
Ductile fracture and random versus regular hole/void arrays
[AD-A176627] N87-21085
VORTEX RINGS
Vorticity generation by shock propagation through bubbles in air
[AD-A176610] N87-21266
VORTEX SHEDDING
Studies in non-linear unsteady aerodynamics
[AD-A177006] N87-20971
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341
VORTICES
Laser Doppler velocimeter measurements in a turbulent junction vortex N87-20964
Experimental studies on the dynamic development and control of unsteady separated flows
[AD-A176376] N87-20969
Studies in non-linear unsteady aerodynamics
[AD-A177006] N87-20971
Computer code for gas-liquid two-phase vortex motions: GLVM
[NASA-CR-180265] N87-21139
Toward the large-eddy simulations of compressible turbulent flows
[NASA-CR-178273] N87-21259
Solution of the three-dimensional Navier-Stokes equations for a turbulent horseshoe vortex flow
[AD-A176370] N87-21263
Stability of the vortex motion in oscillating flow
[AD-A176629] N87-21267
Vortex motion in a stratified medium
[AD-A176729] N87-21269
Flow induction by rotary jets
[AD-A177013] N87-21270
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519
Vortices in long Josephson junctions
[AD-A176916] N87-21695
VORTICITY
Vorticity generation by shock propagation through bubbles in air
[AD-A176610] N87-21266
The quality of the Alpine Experiment (ALPEX) 2b data set with regard to the application of vorticity dynamics N87-21490
Vorticity budgets for Alpine cyclogenesis with and without the forcing of terrain N87-21508
Comparative study of several cases of Alpine lee-cyclogenesis: Kinetic energy and vorticity N87-21512
VULNERABILITY
Cosmic ray effects on microelectronics. Part 4
[AD-A176611] N87-21242

W

WAFERS
Rapid isothermal processing systems: An overview
[RSRE-MEMO-3967] N87-21238
WAKES
Wake interaction effects on the transition process on turbine blades
[AD-A177094] N87-21272
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519
WALL FLOW
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 3: Spectral manifestations of inhomogeneity due to field effects and to the presence of walls
[ETN-87-99396] N87-21295
The influence of the wall boundary condition on a solution of the incompressible Navier-Stokes equation
[VKI-TM-42] N87-21298

WALL PRESSURE
Wavevector-frequency spectrum of transition zone wall pressure fluctuations
[AD-A176855] N87-21268
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655
WALLS
Viscous flow around wall mounted obstacles
[ARL-AERO-PROP-REPT-172] N87-21260
Irregular modes in a duct with an impedance wall
[NLR-MP-85086-U] N87-21656
WARFARE
Present and future military uses of outer space: International law, politics, and the practice of states
[AD-A176722] N87-21753
WARNING SYSTEMS
Ground Proximity Warning System (GPWS): Guidance material
[CAP-516] N87-20977
Fault-tolerant system analysis: Imperfect switching and maintenance
[AD-A176514] N87-20995
Verification of severe local storm forecasts issued by the National Severe Storms Forecast Center, 1985
[PB87-137139] N87-21527
Severe local storm warning verification: 1985
[PB87-137147] N87-21528
WARPAGE
Residual supersymmetry of compactified d=10 supergravity
[NIKHEF-H/86-15] N87-21726
WASTE DISPOSAL
Ductile iron data base. Correlations between microstructure and fracture toughness: Background document for draft ASTM ductile iron specification
[DE87-006010] N87-21107
Report to the Congress on ocean pollution, monitoring and research, October 1984 through September 1985
[PB87-129425] N87-21420
WATER
Raman spectra of water in the translational and librational regions. Part 1: Study of the depolarization ratio
[PREPRINT-534] N87-21071
WATER BALANCE
Individual distinctions of fluid-electrolyte metabolism during hypokinesia with head-down tilt for 120 days and efficacy of preventive agents N87-21562
WATER IMMERSION
Effect of immersion hypokinesia on some parameters of human muscle potentials N87-21564
WATER POLLUTION
Report to the Congress on ocean pollution, monitoring and research, October 1984 through September 1985
[PB87-129425] N87-21420
WATER TEMPERATURE
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539
WATER VAPOR
Tethered balloon measurements made at Naval Air Development Center (December 1985)
[AD-A176254] N87-21517
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21537
WATER WAVES
Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521
WAVE EXCITATION
Scattering from general periodic screens
[AD-A176405] N87-21216
WAVE FUNCTIONS
Magnetic moments of multiquark states and limit on the six-quark bag admixture in the deuteron wave function
[PREPRINT-537] N87-21673
WAVE GENERATION
Millimeter wave generation by relativistic electron beams
[AD-A176949] N87-21245
The effect of beam-driven return current instability on solar hard X-ray bursts N87-21820
WAVE INTERACTION
Scattering from general periodic screens
[AD-A176405] N87-21216
WAVE PROPAGATION
Wave-mode coordinates and scattering matrices for wave propagation
[AD-A176998] N87-21030
VHF radio broadcasting: Propagation and diversity reception of mixed polarised signals over a sea path
[BBC-RD-1987/2] N87-21208
Computational model for the simulation of millimeter-wave propagation through the clear atmosphere
[PB87-131173] N87-21209
A study of the propagation of ULF electromagnetic fields in collisional, inhomogeneous, magnetized plasmas
[DE87-004768] N87-21223
Wavevector-frequency spectrum of transition zone wall pressure fluctuations
[AD-A176655] N87-21268
Normal wave propagation velocity in a static web
[AD-A176539] N87-21380
Wave propagation in periodic truss structures
[AD-A176548] N87-21381
Retrieval of moving waves from polar orbiting satellite data N87-21404
Antarctic atmospheric infrasound
[AD-A176804] N87-21434
WAVE REFLECTION
Numerical boundary conditions with minimal reflection for limited-area models
[KNMI-WR-86-3] N87-21292
WAVE SCATTERING
Wave-mode coordinates and scattering matrices for wave propagation
[AD-A176998] N87-21030
Scattering of surface waves by nonuniform waveguides
[AD-A176632] N87-21219
WAVEGUIDE LASERS
Liquid-core fiber optics: Transmission and nonlinear effects
[DE87-005960] N87-21683
WAVEGUIDES
Scattering of surface waves by nonuniform waveguides
[AD-A176632] N87-21219
Studies of millimeter-wave diffraction devices and materials. Phase 3
[AD-A176917] N87-21244
WEAK INTERACTIONS (FIELD THEORY)
Status of the electroweak theory
[PREPRINT-529] N87-21670
Searching for an intermediate mass Higgs boson at large energy e+e- linear colliders
[PREPRINT-530] N87-21671
Heavy Higgs production at future colliders
[PREPRINT-531] N87-21672
Theoretical summary --- p pbar
[PREPRINT-532] N87-21730
WEAPON SYSTEMS
Energetic materials for military purposes: An assessment
[PB87-137220] N87-21138
WEAR
Wear induced by small amplitude vibrations: Phenomena identification
[ECL-86-11] N87-21359
Multitechnique studies on fretting fatigue: Influence of surface treatment
[AD-A177103] N87-21387
WEAR TESTS
Assessment of remaining lubricant life
[AD-A177186] N87-21121
WEATHER
Atmospheric climate data: Problems and promises
[NASA-CR-180442] N87-21450
Review of the weather phenomena observed during the Alpine Experiment (ALPEX) special observing period N87-21487
WEATHER FORECASTING
GARP's objectives in weather prediction. Expectations and realizations N87-21472
Mariners weather log, volume 30, number 4, Fall 1986
[PB87-129417] N87-21526
Verification of severe local storm forecasts issued by the National Severe Storms Forecast Center, 1985
[PB87-137139] N87-21527
Marine environmental assessment: Chesapeake Bay, December 1985 - February 1986
[PB87-129458] N87-21531
WEATHER STATIONS
Description of the Terschelling wind observation station for the period 1949-1980
[KNMI-TR-86] N87-21523
WEAVING
A comparison of the fatigue performance of woven and non-woven CFRP laminates
[RAE-TR-85059] N87-21041
WEBS (SHEETS)
Normal wave propagation velocity in a static web
[AD-A176539] N87-21380
WEIGHTLESSNESS
Microgravity Fluid Management Symposium
[NASA-CP-2465] N87-21141
Effect of immersion hypokinesia on some parameters of human muscle potentials N87-21564
Quantitative study of osteoblasts and osteoclasts of rat bones with simulation of weightlessness N87-21566
Mechanism of action of local negative pressure applied to human body on dynamics of central circulation N87-21579
WELD STRENGTH
Laser welding metallography
[DE87-004113] N87-21348
WELD TESTS
Submerged arc welding of high strength structural steels
[VTT-436] N87-21361
Mechanical properties of welded joints in two fine-grained steels with yield strength of 370 N/mm(sup)2
[VTT-441] N87-21399
WELDED JOINTS
Effects of irradiation on the fracture toughness of Alloy 718 plate and weld
[DE87-004345] N87-21102
Laser welding metallography
[DE87-004113] N87-21348
Mechanical properties of welded joints in two fine-grained steels with yield strength of 370 N/mm(sup)2
[VTT-441] N87-21399
WELDING MACHINES
Ultrasonic detection of weld bead geometry
[DE87-000441] N87-21366
WHISKER COMPOSITES
Development of alumina- and mullite-SiC whisker composites: High temperature properties
[DE87-004824] N87-21052
WHITE DWARF STARS
Theoretical and observational review of results on nova explosions occurring on ONeMg white dwarfs
[DE87-001962] N87-21772
White dwarf models of supernovae and cataclysmic variables
[DE87-004172] N87-21773
Pulsations of white dwarf stars with thick hydrogen or helium surface layers
[DE87-001954] N87-21774
WIND (METEOROLOGY)
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
Wind forcing experiments in the California current system
[AD-A176818] N87-21545
The interchange instability in high-latitude plasma blobs
[AD-A176242] N87-21685
WIND MEASUREMENT
The determination of lee circulation during the Foehn wind N87-21465
Principles of wind measurement with the help of aircraft N87-21469
Improvements in geostationary satellite wind observations as a result of the Global Weather Experiment and applications of these in the context of the World Weather Watch (WWW) system N87-21476
Ship-borne systems for observing wind in the tropical zone N87-21480
Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521
Description of the Terschelling wind observation station for the period 1949-1980
[KNMI-TR-86] N87-21523
WIND PROFILES
Measurements of the vertical structure of the convective boundary layer N87-21461
Partioning of the vertical turbulent energy transport into positive and negative contributions N87-21462
Navigational Aid (NAVAID) vertical sounding system — atmospheric sounding N87-21479
WIND SHEAR
Thunderstorm influence on boundary layer winds
[AD-A176543] N87-21518
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519
WIND TUNNEL APPARATUS
Activities report of the large testing facilities — wind tunnels
[ETN-87-99376] N87-21007
WIND TUNNEL MODELS
Activities report of the large testing facilities — wind tunnels
[ETN-87-99376] N87-21007

WIND TUNNEL TESTS
Aircraft and engine development testing
[AD-A176711] N87-20961
Summary of studies to reduce wing-mounted propfan installation drag on an M = 0.8 transport
[NASA-TP-2678] N87-20990
Activities report of the large testing facilities — wind tunnels
[ETN-87-99376] N87-21007
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 4: Study of entrainment mechanisms using simulations and experimental results
[ETN-87-99397] N87-21296
WIND TUNNELS
Activities report of the large testing facilities — wind tunnels
[ETN-87-99376] N87-21007
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
WIND VELOCITY MEASUREMENT
Determination of vertical air velocity using measurements of the aircraft motion N87-21456
Influencing variables in the assessment of vertical wind velocity by means of flight-mechanics equations N87-21457
WINGS
Wing divergence and structural distortion
[RAE-TR-85057] N87-20989
WINTER
Spread F: The Scandinavian scene
[UIO-SR-86-02] N87-21443
WIRE
Design of low carbon dual-phase steels for high strength wire
[DE87-006169] N87-21104
WORK CAPACITY
Reactivity of adrenosympathetic system and tolerance to exercise load during repeated exposure to stationary magnetic field N87-21573
WORK HARDENING
Stage 4 work hardening in cubic metals
[DE87-003756] N87-21094
WORLD DATA CENTERS
The Mediterranean-Alpine Experiment (MED-ALPEX) data set N87-21489

X

X RAY LASERS
Muonic X-ray laser assisted by catalyzed fusion of deuterium and tritium
[DE87-004851] N87-21327
Multifacet, metal mirror design for extreme-ultraviolet and soft X-ray free-electron laser resonators
[DE87-005100] N87-21328
X RAY SOURCES
Dynamical evolution of spherical stellar systems N87-21767
X RAY SPECTRA
LLE review
[DE87-005865] N87-21324
The hard X-ray to low energy Gamma-Ray spectrum of the crab nebula N87-21761
Sub-second variations of high energy (300 keV) hard X-ray emission from solar flares N87-21787
The possible importance of synchrotron/inverse Compton losses to explain fast mm-wave and hard X-ray emission of a solar event N87-21802
Rapid spectral and flux time variations in a solar burst observed at various dm-mm wavelengths and at hard X-rays N87-21803
X RAYS
The application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce N87-21198
Rapid Fluctuations in Solar Flares
[NASA-CP-2449] N87-21785
Interpretation of rapid rises in hard X-rays and microwaves with the thermal conduction front model N87-21788
Impulsive phase solar flare X-ray polarimetry N87-21789
Persistent time intervals between features in solar flare hard X-ray emission N87-21790
Evidence for beamed electrons in a limb X-ray flare observed by Hard X-Ray Imaging Spectrometer (HXIS) N87-21791
Statistical analysis of fast hard X-ray bursts by SMM observations and microwave bursts by ground-based observations N87-21793
Microwave and hard X-ray emissions during the impulsive phase of solar flares: Nonthermal electron spectrum and time delay N87-21794
Hard X-ray imaging observation of fluctuating bursts N87-21795
Hard X-ray delays N87-21796
Relation between solar narrow-band decimeter wave bursts and associated X-ray bursts N87-21799
Quasi-periodic pulsations in solar hard X-ray and microwave flares N87-21804
Temporal frequency of radio emissions for the April 25, 1984 flare N87-21808
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810
A search for fast variations in the Fe XXi emission during solar flares N87-21811
A third class of high energy burster
[DE87-006051] N87-21841
X-29 AIRCRAFT
Challenges in modeling the X-29 flight test performance
[NASA-TM-88282] N87-20991
XENON 129
Laser microprobe studies of rare gas isotopes in meteorites N87-21769

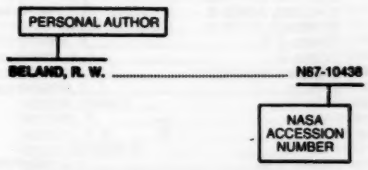
Y

YIELD POINT
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384
YIELD STRENGTH
Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels
[DE87-004000] N87-21092
Effect of aluminum addition on ductility and yield strength of Fe3Al alloys with 0.5 wt % TiB2
[DE87-004621] N87-21098
On the correlation of hardness with tensile and yield strength
[VTT-416] N87-21109
Mechanical properties of welded joints in two fine-grained steels with yield strength of 370 N/mm(sup)2
[VTT-441] N87-21399
YTTRIUM
Oxidation behavior of chromium and a chromium-yttrium binary alloy
[DE87-003772] N87-21095
YTTRIUM COMPOUNDS
Precision cutting and drilling with the Nd-YAG laser
[DE87-001359] N87-21317

Z

ZINC SELENIDES
Investigation into the characteristics of ZnSe filters
[RSRE-MEMO-3993] N87-21680
ZIRCONIUM OXIDES
Laser evaporation studies
[AD-A176826] N87-21313
ZOOPLANKTON
Is the Somali Current a biological river in the Northwestern Indian Ocean
[DE87-003233] N87-21548

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.

A

ABRAHAMSSON, S. N87-21227
ABROSIMOV, S. V. N87-21562
ACHAR, BAPPALIGE N. N87-21112
ACKERMAN, J. L. N87-21123
ADAMS, JAMES H., JR. N87-21242
ADAMS, T. I. N87-21746
N87-21747
AFONIN, B. V. N87-21569
AGGSON, T. N87-21024
AGIN, GERALD J. N87-21340
AHN, J. H. N87-21104
AIELLO, ROBERT A. N87-21375
ALADZHADZHYAN, SAMUEL H. N87-21660
ALGER, DONALD L. N87-21756
ALLAMANDOLA, L. J. N87-21075
N87-21760
ALLISON, S. W. N87-21683
ALLY, M. R. N87-21415
ALM, A. N87-21227
ALONSO, S. N87-21510
ALPING, A. N87-21681
ALTARELLI, G. N87-21670
N87-21671
N87-21672
N87-21730
ALYEA, FRED N. N87-21428
AMINPOUR, M. A. N87-21377
AMSDEN, A. A. N87-21344
ANDERSEN, GREGORY C. N87-21021
ANDERSON, LLOYD L., JR. N87-21432
ANDERSON, R. R. N87-21440
ANDERSSON, BOERJE N87-21400
N87-21401
ANGLIN, C. D. N87-21317
ANTONIAK, ZENEN I. N87-21154
ARMSTRONG, W. T. N87-21686
ARNOLD, G. W. N87-21703
ARNOULT, DANIEL N87-21687
ARNROTH, ROGER N87-21609
ARTAMASOVA, YE. M. N87-21565
ARTAMONOVA, N. P. N87-21563
ARZAMAZOV, G. S. N87-21563
ASLANOVA, I. F. N87-21564
ASSIAN, W. A. H. N87-21419
AUBERTON-HERVE, ANDRE-JACQUES N87-21716
AUERKARI, PERTTI N87-21109
AUVINE, BRIAN N87-21533
AUZOLLE, F. N87-21191

B

BABCOCK, S. M. N87-21351
BABICHENKO, I. I. N87-21569
BACON, D. R. N87-21311
BADER, M. G. N87-21044
BAER, M. R. N87-21280
BAI, TAEIL N87-21787
N87-21838
N87-21839
BAILEY, R. N87-21663
BALL, WILLIAM N87-21406
BALLARD, S. N87-21746
N87-21747
BAME, S. J. N87-21775
BANKS, BRUCE A. N87-21160
BARAN, GREGORY PAUL N87-21760
BARAT, C. N87-21790
BARD, A. J. N87-21137
BARER, A. S. N87-21577
BARHEN, J. N87-21618
N87-21620
BARKER, J. R. N87-21075
N87-21760
BARNARD, J. W. N87-21590
BASHORE, T. L. N87-21531
BASKAR, S. N87-21371
BASSANI, J. L. N87-21091
BATCHELOR, D. A. N87-21788
BATTIMELLI, G. N87-21732
BATTS, COLOSSIE N. N87-21235
BAUM, H. R. N87-21302
BAUM, J. D. N87-21036
BEALE, EDWARD G., JR. N87-21539
BEAUCHAMP, R. N87-21250
BECHER, P. F. N87-21052
BELAU, E. N87-21663
BELEW, ROBERT N87-21332
BELL, M. I. N87-21368
BENGTSSON, LENNART N87-21461
BENJAMIN, J. D. N87-21161
N87-21162
N87-21237
BENNETT, B. W. N87-21081
BENNETT, W. H. N87-21388
BENOCCI, C. N87-21297
N87-21298
N87-21301
BENSEMA, W. D. N87-21749
BENZ, A. O. N87-21798
BERDING, M. N87-21086
BERGER, M. J. N87-21286
BERGIN, JOHN M. N87-21538
BERNHARDT, A. F. N87-21320
BERNHARDT, P. A. N87-21440
BERNSTEIN, DENNIS S. N87-21025
BERRY, MICHAEL J. N87-21316
BERRY, V. L. N87-21373
BERTOGLIO, J. P. N87-21294
N87-21296
BESMANN, T. M. N87-21675
BEYER, JAMES B. N87-21695
BHAN, O. K. N87-21135
BHATTACHARYA, P. K. N87-21709
BICEN, A. F. N87-21184
BICKES, R. W., JR. N87-21186
BIEFELD, R. M. N87-21703
BIGGS, G. L. N87-21283
BINDSLEVHANSEN, J. N87-21700
BINZEL, RICHARD PETER N87-21768
BIRD, ARLENE A. N87-21541
N87-21542
N87-21544
BIRX, D. N87-21642
BLANKENSHIP, G. L. N87-21388
BLOEMBERGEN, N. N87-21124
BLOEMBERGEN, NICOLAAS N87-21087
BLOM, A. F. N87-21398
BLOM, NICO SELHORST N87-21719
BLOTTNER, F. G. N87-20972
BLUME, HANS-JUERGEN C. N87-21206
BOCHICCHIO, MARCO N87-21729
BODNER, SOL R. N87-21386
BODROV, V. A. N87-21561
BOEHRINGER, T. N87-21663
BOICE, D. C. N87-21783
BOISSIERE, P. T. N87-21353
BOLIN, BERT N87-21471
BONIFACE, L. N87-21044
BORGHI, ROLAND N87-21289
BORIS, J. P. N87-21266
BOROVSKY, J. E. N87-21223
BOS, H. J. N87-21605
BOSMAN, M. N87-21663
BOUAZDIALAKHDARI, DZAIR N87-21397
BOUTIER, A. N87-21179
BOWERS, JAMES N87-21243
BOWLES, KENNETH J. N87-21043
BOWMAN, D. R. N87-21705
BOYCE, J. F. N87-21597
BOYER, DON L. N87-21516
BRACKE, P. N87-21678
BRADDOCK, WILLIAM F. N87-21015
N87-21016
N87-21017
BRAUDAWAY, D. W. N87-21308
BRAUN, BARBARA N87-21492
BRAUN, E. N87-21169
BRAUNSTEIN, G. N87-21124
[illegible], W. R. N87-21283
BRILEY, W. R. N87-21264
BRINKMAN, D. W. N87-21135
N87-21136
BROOKS, GEORGE W. N87-21020
BROSCIOUS, J. N87-21168
BROWN, J. C. N87-21820
N87-21825
BROWN, JOHN C. N87-21818
BROWN, M. N87-21250
BROWN, NORMAN S. N87-21142
BROWNE, D. R. N87-21549
BROZENA, JOHN M. N87-20993
BRUEMMER, S. M. N87-21105
BRUERE, A. N87-21195
BRUNEL, F. N87-21827
BRUYNSERAEDE, Y. N87-21706
N87-21708
BRYANOV, I. I. N87-21559
BRYANSTON-CROSS, P. J. N87-21202
N87-21203
BRYANT, A. N87-21082
BUCH, A. N87-21374
BUCHLIN, J. M. N87-21193
BUCHLIN, J.-M. N87-21301
BUCHWALD, M. I. N87-21686
BUCKINGHAM, A. C. N87-21281
BUGGELIN, R. C. N87-21283
BULLARD, J. B. N87-21192
BUNNIK, N. J. J. N87-21408
BURENKO, O. N87-21393
BURGER, J. M. N87-21744
BURR, C. A. N87-21418
BUZZI, A. N87-21487
N87-21499
N87-21500
BYERS, C. H. N87-21262
BYERS, DAVID C. N87-21037
BYRD, ALAN K. N87-21265
BYRD, J. S. N87-21352
BYRNES, H. S. N87-21134

C

CALCO, FRANK S. N87-21234
CALEDONIA, G. N87-21315
CALOGERO, FRANCESCO N87-21635
CALVERT, JOHN A. N87-21333
CAMPBELL, J. N87-21315
CAMPION, A. N87-21137
CANFIELD, RICHARD C. N87-21810
CANTLEY, DOUGLAS N87-21540
CANTRELL, JOHN H., JR. N87-21653
CARLSON, N. M. N87-21388
CARLSSON, L. N87-21227
CARLSTEDT, O. N87-21227
CARNE, T. G. N87-21395
CARROLL, H. A. N87-21421
CASSEL, LEROY A. N87-21022
CASTELLINS, CORNELIS ADRIANUS MARCELLUS
N87-21300
CASTELLANI, C. N87-21638
N87-21674
CATES, M. R. N87-21683
CEBECI, TUNCER N87-20970
CESUR, CEYHUN N87-21261
CHABAUD, V. N87-21663

CHAN, Y. T. N87-21693
CHANAN, GARY N87-21789
CHANG, CHIN-WEN N87-21546
CHANG, D. L. N87-21046
CHASE, DAVID M. N87-21655
CHATURVEDI, P. K. N87-21685
CHAUCHARD, E. A. N87-21251
CHEN, A.-B. N87-21088
CHEN, GOONG N87-21389
CHEN, H. N87-21702
CHEN, RUIRONG N87-21516
CHEN, ZHI-JUN N87-21809
CHENG, CHUNG-CHIEH N87-21811
CHESTON, T. C. N87-21218
CHITANVIS, S. M. N87-21322
CHOLLET, JEAN-PIERRE N87-21289
CHUCHKALOV, B. S. N87-21480
CHURCH, R. H. N87-21723
CHUTJIAN, ARA N87-21660
N87-21661
CIANDRO, MELISSA L. N87-21541
N87-21542
N87-21544
CITERLEY, RICHARD L. N87-21378
CLAMONS, J. D. N87-20993
CLARK, A. F. N87-21715
CLARK, WILLIAM S. N87-21083
CLARKE, J. N87-21700
CLAWSON, K. L. N87-20987
CLIVER, E. W. N87-21803
CLOYD, RICHARD A. N87-21333
COCKING, J. L. N87-21079
COFFEY, H. E. N87-21449
COFFEY, HELEN E. N87-21448
N87-21836
COHEN, M. N87-21780
COLDREN, LARRY A. N87-21681
COLLIN, GERARD N87-21175
COLOMBIE, CHRISTIAN N87-21359
CONFORTO, A. M. N87-21678
CONNELL, P. S. N87-21438
COOK, W. A. N87-21391
COOKE, CHATHAN M. N87-21029
CORE, P. W. N87-21599
CORLEY, D. M. N87-21302
CORREIA, E. N87-21802
N87-21803
CORYNEN, G. C. N87-21224
COSTA, J. E. R. N87-21802
N87-21803
COTELL, C. M. N87-21095
COTTEN, RANDOLPH P. N87-20992
COURBIERE, MICHEL N87-21360
COX, A. N. N87-21774
N87-21776
COX, KENNETH N87-21406
COX, M. G. N87-21623
CRAVEN, P. D. N87-21024
CRAWFORD, ALICE M. N87-21589
CRAWLEY, EDWARD F. N87-21147
CREWS, J. H., JR. N87-21377
CROLEY, D. R., JR. N87-21024
CROMWELL, D. N87-21820
CRONENBROECK, W. N87-21293
CRONKHITE, J. D. N87-21373
CROSS, KENNETH D. N87-21586
CROWLEY, W. P. N87-21279
CRUIKSHANK, DALE P. N87-21763
CRUZ, JAIME V. N87-21431
N87-21435
CUNNOLD, DEREK M. N87-21428
CURTIS, P. T. N87-21041
CUTHRELL, W. F. N87-21074
CWIK, THOMAS N87-21216
CZARNECKI, MICHAEL F. N87-21538

D

DAGAMA, R. M. S. N87-21277
DAHMEN, U. N87-21392
DALU, G. N87-21497
DALY, P. W. N87-21784
DAMERELL, C. N87-21663
DANFORD, MERLIN D. N87-21076
DANGELO, N. N87-21684
DANIEL, B. R. N87-21063
DANIEL, I. M. N87-21047
DANIELSEN, C. N87-21446
DANUSSO, L. N87-21678
DARLINGTON, D. J. N87-21208
DATTA, SUPRIYO N87-21696
DAUM, C. N87-21663
N87-21676
DAVIES, PETER A. N87-21516
DAVIS, R. T. N87-20972
DAWSON, L. R. N87-21703
N87-21711
DEBERRY, DAVID W. N87-21083
DECKER, ARTHUR J. N87-21204
DEDMAN, R. T. N87-21236
DEFELICE, DAVID M. N87-21150
DEHAAS, JOHANNES CORNELIS MARIA N87-21686
DELAMERE, W. A. N87-21782
DELL, G. F. N87-21697
N87-21698
DELLOSSO, L. N87-21503
DEMERS, ROSARIO N. N87-21200
DEMINCO, N. N87-21228
DEMOEL, R. P. N87-21743
DENEUVY, ANNE-CLAIRE N87-21396
DENISSEN, CORNELIS JOHANNES MARIA . N87-21720
DENNIS, B. R. N87-21797
N87-21802
DENNIS, BRIAN R. N87-21785
DENNISON, B. K. N87-21758
DEO, R. B. N87-21050
DEPAUW, JAMES F. N87-21156
DERBLOM, HARALD N87-21443
DERIJK, G. N87-21663
DESAI, UPENDRA D. N87-21790
DESANTIS, A. N87-21071
DESAUSSURE, G. N87-21345
N87-21350
N87-21354
DEVINE, M. D. N87-21746
N87-21747
DEWIT, B. N87-21728
DICASTRO, C. N87-21638
N87-21674
DICKINSON, R. E. N87-21530
DICKSON, C. R. N87-20987
DIGE, MARK W. N87-21248
DIJKSTRA, H. N87-21663
DILLER, T. E. N87-21276
DING, KURT N87-21199
DINGUS, R. S. N87-21329
DIPIRRO, MICHAEL J. N87-21151
DISQUE, ROBERT C. N87-21051
DOEOES, B. R. N87-21474
DOHERTY, R. D. N87-21094
DOLL, DAN N87-21034
DOLLING, KERSTIN N87-21745
DOMPKA, R. V. N87-21373
DONALDSON, J. R. N87-21641
DONKER, J. C. N87-21621
N87-21622
DOO, YI C. N87-21039
DOONG, W. N87-21212
N87-21213
DORR, DAN W. N87-20982
DOUGHTY, M. W. N87-21347
DOYLE, B. L. N87-21703
DRAPER, J. V. N87-21355
DRAXLER, R. R. N87-21418
DRESS, HENRY P. N87-21189
DRESSELHAUS, M. S. N87-21124
DREW, D. A. N87-21287
DUBENSKY, E. M. N87-21065
DULK, G. A. N87-21821
DUNLOP, J. N87-21250
DURAO, D. F. G. N87-21185
DURNOVA, G. N. N87-21566
DYACHENKO, A. I. N87-21579
DYBDAL, ROBERT B. N87-21215

E

EARL, M. N87-21250
EBEL, KEVIN C. N87-21023
EBIHARA, BEN T. N87-21239
ECKE, R. E. N87-21275
ECKHAUS, WIKTOR N87-21635
EDWARDS, J. A. N87-21161
EDWARDS, THOMAS D. N87-21132
EDWIN, P. M. N87-21822
EINSTEIN, J. R. N87-21618
N87-21620
EKIN, J. W. N87-21715
ELDER, R. L. N87-21180
ELEN, J. D. N87-21689
ELHAJRI, JILALI N87-21067
ELIASSON, LARS N87-21444
ELIEZER, S. N87-21327
ELLINGSON, W. A. N87-21123
ELLIS, J. T. N87-21712
ELLISON, DONALD C. N87-21823
ELLISON, L. N87-21746
N87-21747
ELMAGHRABY, SALAH E. N87-21364
ELROD, S. A. N87-21062
ELWERT, GERHARD N87-21791
EMEIS, S. N87-21511
EMERY, V. J. N87-21699
EMSLIE, A. G. N87-21825
EMSLIE, A. GORDON N87-21789
ENGEL, CARL D. N87-21012
N87-21013
N87-21014
ENGLEMAN, M. S. N87-21262
ENOME, SHINZO N87-21799
N87-21831
EPSTEIN, ALAN H. N87-21341
EPSTEIN, J. S. N87-21053
ERLEBACHER, G. N87-21259
ERNST, MICHAEL A. N87-21375
ESCANDE, BEATRICE N87-21291
ESKINZES, JAMES C. N87-20993
ETHRIDGE, EDWIN C. N87-21111
EVANS, C. R. N87-21771
EVANS, M. L. N87-21421
EVERETT, RICHARD K. N87-21118
EYRAUD, J. L. N87-21191

F

FALCO, C. M. N87-21714
FALK, URBAN N87-21400
N87-21401
FALL, MARK K. N87-21189
FANG, TA-MING N87-21437
FARMER, JEFFERY T. N87-21021
FARNHAM, G. D. N87-21383
FARRAR, A. N87-21230
FARROW, R. L. N87-21173
FARRUKH, U. O. N87-21429
FATHI, YAHYA N87-21384
FEA, MAURIZIO N87-21495
FEDOR, OTTO H. N87-21755
FEDORUK, A. G. N87-21561
FELL, PATRICK J. N87-20983
FENIMORE, E. E. N87-21841
FENNELL, J. F. N87-21024
FERRANTE, J. N87-21078
FERRANTE, M. J. N87-21733
FERRARI, E. N87-21731
FERREIRA, J. L. N87-21348
FERRELL, WILLIAM G., JR. N87-21384
FERRISS, D. H. N87-21370
FEUERSTEIN, H. N87-21677
FIELD, S. P. N87-21033
FILLOT, JEAN-JACQUES N87-21068
FIMPEL, HANS P. N87-21493
FINKEL, MITCHELL W. N87-21679
FISH, RICHARD H. N87-21584
FISHER, C. W. N87-21549
FISHER, J. J. N87-21346
N87-21352
FITZPATRICK, D. K. N87-21705
FLAMMER, K. R. N87-21784
FLETCHER, G. L. N87-21100
FLINN, J. E. N87-21100
FLUGEL, CHARLES N87-21155
FOA, JOSEPH V. N87-21270
FOERSTER, W. N87-21182
FOHLEN, GEORGE M. N87-21112
FOKAS, A. S. N87-21644
FOLEY, ROBERT D. N87-20995
FOLLSTAEDT, D. M. N87-21318
N87-21713
FONTIJN, ARTHUR N87-21061
FORSTER, C. P. N87-21180
FORTINI, ANTHONY F. N87-21149
FOSTER, C. A. N87-21343
FOSTER, J. M. N87-21599
FOUTCH, DAVID W. N87-21129
FOX, C. J. N87-21843
FOX, M. A. N87-21137
FRANCIS, GLEN D. N87-21380
FRANCO, E. N87-21669
N87-21671
FRANKEL, S. N87-21610
FRANKLIN, ELEANOR I. N87-21554
FRATTINI, R. N87-21071
FRENZEN, G. N87-21512
FRIEDLANDER, AMY I. N87-21543
FU, QI-JUN N87-21809
N87-21819
FU, QIJUN N87-21805
FUJITA, Y. N87-21355

G

GABELLIERI, M. N87-21447
GABRIELLI, EMIDIO N87-21637

GALBRAITH, N. R. N87-21551
GALIOTIS, C. N87-21049
GALLAGHER, BRIAN D. N87-21334
GANNON, KEVIN P. N87-21338
GARCIA-MOYA, J. A. N87-21510
GARCIA, C. N87-21837
GARCIA, DANA N87-21043
GARRIS, CHARLES A. N87-21270
GARRISON, JAMES N87-21021
GATES, R. K. N87-21382
GAYLEY, KENNETH G. N87-21810
GAZENKO, O. G. N87-21558
GEERINCK, J. N87-21676
GENTRY, W. N87-21250
GEORGES, T. M. N87-21659
GERBER, H. N87-21517
GETTYS, JIM N87-21604
GIBALA, R. N87-21709
GIBBS, A. J. N87-21704
GIBELING, H. J. N87-21683
GIBSON, G. J. N87-21382
GIBSON, JOHN C. N87-21333
GICQUEL, P. N87-21201
GIDIKOV, A. A. N87-21564
GILES, MICHAEL B. N87-21341
GILL, M. E. N87-21180
GILL, S. N87-21663
GILL, SUKHDEV S. N87-21238
GILLIES, G. T. N87-21683
GIMENO, C. N87-21502
GITOMER, S. J. N87-21329
GLOECKLER, G. N87-21784
GODEFROY, J. C. N87-21195
GOEPEL, W. N87-21059
GOERSS, J. S. N87-21515
GOERTZ, C. K. N87-21684
GOKHALE, MAYA B. N87-21613
GOLAND-RUVINOVA, L. G. N87-21567
GOLDBERG, B. A. N87-21784
GOLDMAN, LOUIS J. N87-21183
GOLDMAN, T. N87-21725
GOLDSTEIN, DAVID M. N87-21090
GONCHAROVA, N. P. N87-21567
GOODING, A. N87-21262
GOODRICH, L. F. N87-21715
GOSLING, J. T. N87-21775
GOTTSTEIN, G. N87-21103
GOVINDAN, T. R. N87-21264
GRADIE, JONATHAN C. N87-21781
GRAHAM, G. N87-21686
GRAHN, P. N87-21227
GRANT, DAVID E. N87-21536
GRATTIDGE, W. N87-21750
GRAVES, DENISE STEPHENSON N87-21422
GRAY, J. L. N87-21416
GREENHALGH, DOUGLAS A. N87-21172
GREITZER, EDWARD M. N87-21341
GRENIER, L. A. N87-21528
GRISHAYENKOV, B. G. N87-21575
N87-21576
GRUBIN, H. L. N87-21693
GU, D.-W. N87-21627
GU, YE-MING N87-21794
GUNSHOR, ROBERT L. N87-21696
GURMAN, J. L. N87-21169
GURNETT, D. A. N87-21440
N87-21684
GUY, C. R. N87-21002
GUYENNE, T. D. N87-21766
GYSEL, P. N87-21494

H

HACKER, JOERG M. N87-21462
N87-21464
HAERENDEL, G. N87-21440
HAGENBERG, T. H. M. N87-20981
HAHN, H. T. N87-21116
HAHN, KLAUS-UWE N87-21457
HALLOWELL, GARY M. N87-20979
HALMAN, JENNIFER I. N87-21244
HAMADA, T. N87-21476
HAMEL, W. R. N87-21351
HAMMOND, R. B. N87-21704
N87-21705
HANDEL, S. J. N87-21355
HANNA, W. D. N87-21046
HANSMAN, R. JOHN N87-21147
HANSON, W. B. N87-21427
HANTEL, M. N87-21511
HARADA, M. N87-21795
HARIDASS, N. D. N87-21728
HARRINGTON, ROGER F. N87-21217
HARRIS, ANDREW IRWIN N87-21759
HARTJES, F. N87-21310
HASHIMOTO, M. N87-21773
HAUCKE, H. N87-21275
HAUG, EBERHARD N87-21791
HAUSE, L. G. N87-21229
HAUSKEN, T. R. N87-21681
HAUSMAN, B. A. N87-21808
HAWKINS, JEFFREY D. N87-21537
HAWTHORNE, EDWARD W. N87-21554
HAYDEN, C. M. N87-21496
HAYES, FRED N87-21034
HAZELL, M. S. N87-21680
HEALD, S. M. N87-21702
HEATH, M. T. N87-21594
HEDLIN, E. N87-21737
HEEREMA, F. J. N87-21741
HEFFTER, J. L. N87-21418
HEITOR, M. V. N87-21184
N87-21185
HELDT, L. A. N87-21097
HELIAS, F. N87-21195
HELIN, HENRY E. N87-20969
HELLER, R. N87-21676
HELLSTEN, H. N87-21227
HEMSCH, MICHAEL J. N87-21010
HENCKEN, K. R. N87-21186
HENDERSON-SELLERS, A. N87-21530
HENRY, D. N87-21201
HEREDIA, M. A. N87-21510
HERM, RONALD R. N87-21062
HERMAN, RICHARD H. N87-21389
HERNDON, J. N. N87-21355
HEUSER, ALBERT N87-21361
N87-21399
HEYDEMANN, P. L. M. N87-21651
HICKS, JOHN W. N87-20991
HILL, DAVID K. N87-21507
HILL, RONALD C. N87-21556
HILLEGERS, LEO THOMAS MARIA EMMANUEL
N87-21630
HOCH, T. N87-21186
HOCHSTEIN, JOHN I. N87-21148
HOEN, T. G. M. N87-21557
HOFFMAN, R., JR. N87-21078
HOHLFELD, ROBERT N87-21437
HOINKA, KLAUS P. N87-21465
HOLBACK, BENGT N87-21444
HOLM, D. K. N87-21398
HOLMAN, GORDON D. N87-21824
HOLOPAINEN, EERO N87-21483
HOMMA, H. N87-21706
N87-21708
HONECY, F. N87-21078
HOOPER, W. P. N87-21517
HOPPONEN, J. D. N87-21209
HORTAL, M. N87-21502
HORTON, J. A. N87-21096
HOUPIS, C. H. N87-21617
HOUSE, FREDERICK B. N87-21764
N87-21834
HREBIEN, LEONID N87-21587
HU, CHU-MIN N87-21809
HUANG, C. Y. N87-21124
N87-21251
HUANG, T. C. N87-21681
HUBA, J. D. N87-21685
HUBER, PETER N87-21467
HUEBNER, W. F. N87-21782
N87-21783
HUGHES, J. A. N87-21282
HUGHES, R. J. N87-21725
HUNT, J. C. R. N87-21514
HURLEY, K. N87-21790
HUSAR, R. B. N87-21529
HUSSAINI, M. Y. N87-21259
HUSTON, S. L. N87-21835
HUTTER, MARKUS N87-21458
N87-21460

I

IRVINE, R. D. N87-21130
IVANOV, V. M. N87-21566
IZAGUIRRE, F. N87-21046

J

JANKOWSKI, A. F. N87-21108
JANSA, A. N87-21502
N87-21510
JANSSEN, A. J. N87-21419
JARLAAS, ROLF N87-21400
JEANDEL, D. N87-21296
JEANNE, PHILIPPE N87-21055
JEANNIN, LAURENT N87-21358
JEFFERSON, D. N87-21618
N87-21620
JENNETT, LISA A. N87-20966
JIANG, SHU-YING N87-21793
JIANG, SHUYING N87-21805
JIN, CHANG-JIANG N87-21457
JIN, SHENG-ZHEN N87-21809
JOCHUM, ANNE M. N87-21461
JOHNS, W. L. N87-21347
JOHNSON, D. R. N87-21122
JOHNSON, DAVID S. N87-21475
JOHNSON, DONALD R. N87-21507
JOHNSON, J. A. N87-21366
JOHNSON, R. P. N87-21325
JOHNSON, V. J. N87-21353
JOHNSTON, K. J. N87-21758
JONES, JACK A. N87-21159
JONES, OGDEN S. N87-21149
JONES, R. M. N87-21659
JONES, W. H. N87-21184
JOSSERAND, M. A. N87-21266
JUNG, GREGORY VICTOR N87-21761
JUST, TH. N87-21171

K

KABACOFF, LAWRENCE T. N87-21090
KACHANOV, MARK N87-21385
KAEMPFER, N. N87-21817
KAI, K. N87-21800
N87-21832
KALANDAROVA, M. P. N87-21560
KALASHNIKOV, N. I. N87-21028
KAMMER, D. W. N87-21345
N87-21350
N87-21354
KAN, H. P. N87-21050
KANDA, M. N87-21658
KANIA, JAN N87-20991
KANTOR, P. B. N87-21752
KAPLANSKIY, A. S. N87-21566
KARL, R. N87-21686
KARLICKY, MARIAN N87-21801
KARPPI, RISTO N87-21361
N87-21390
KASSNER, T. F. N87-21099
KATZ, U. N87-21063
KAUFFMAN, ROBERT E. N87-21121
KAUFMANN, P. N87-21802
N87-21803
KAYSER, H. J. N87-21222
KEADY, J. J. N87-21783
KELLER, H. U. N87-21782
KELLY, K. L. N87-21531
KEMP, N. N87-21315
KENNEDY, P. J. N87-21530
KENT, G. S. N87-21429
KEPHART, J. F. N87-21329
KESPE, VOLKER N87-21463
KETCHUM, W. J. N87-21018
KHAYDAKOV, M. S. N87-21566
KHRISTOVA, L. G. N87-21564
KIDMAN, R. B. N87-21774
KILLOUGH, S. M. N87-21351
KIM, M. G. N87-21392
KIM, SEUK-BUOM N87-21040
KIMMEL, CHARLES D. N87-21770
KINSLOW, R. N87-21050
KIPLINGER, ALAN L. N87-21785
N87-21804
KIRBY, P. J. N87-21187
KIRENSKAYA, A. V. N87-21564
KIRSCHBAUM, CHARLES LOUIS N87-21769
KITTEL, PETER N87-21145
KJELLGREN, J. N87-21227
KLEBESADEL, R. W. N87-21841
KLEIN, K. L. N87-21792
KLEINBERG, LEONARD L. N87-21232
KLIMOVSKAYA, L. D. N87-21573
KNAPP, J. A. N87-21713
KNAUER, W. N87-21163
KNAUSS, W. G. N87-21382
KNOCKEMUS, WARD W. N87-21076
KNOELL, HARTWIG N87-21197
N87-21199
KOCKS, U. F. N87-21094
KOEPKE, G. H. N87-21749
KOKOF'VA, L. V. N87-21573
KOLODZ€JSKI, L. A. N87-21696
KOLTON, E. N87-21231
KOMHYR, W. D. N87-21426
KOMPENHANS, J. N87-21205
KONDRACHUK, A. V. N87-21572
KONDRATYUK, L. N87-21673
KOPP, R. A. N87-21329

KOSCHEL, W. N87-21188
KOSS, D. A. N87-21084
N87-21085
KOSUGI, T. N87-21827
KOSUGI, TAKEO N87-21804
KOUTCHER, J. A. N87-21123
KOUVELIOTOU, CHRYSSA N87-21790
KOVALEV, V. YU. N87-21580
KOWALENKO, V. N87-21008
N87-21009
KOZLOVA, V. G. N87-21564
KOZLOVSKAYA, I. B. N87-21564
KOZMINCHUK, BRIAN W. N87-20978
KOZYREVSKAYA, G. I. N87-21562
KRASNOV, I. B. N87-21569
KRAUS, HELMUT N87-21454
KRECH, R. N87-21315
KREIJKAMP, H. A. N87-21741
KRESIN, V. Z. N87-21701
KREUTNER, W. N87-21171
KRISHMAIAH, P. R. N87-21637
KRIST, STEVEN E. N87-20968
KRIVORUCHENKO, M. N87-21673
KROEHL, H. W. N87-21808
KRUGER, JEROME N87-21089
KRUSE, H. N87-21182
KRUSE, ROBERT L. N87-20967
KRUSS, JAAN N87-21478
KRYLOV, YU. V. N87-21570
KUETTNER, J. P. N87-21486
KUIJPERS, J. N87-21807
KUIN, ADRIANUS JOSEF N87-21299
KUNDU, MUKUL R. N87-21833
KUNHARDT, ERICH E. N87-21247
KUO, S. P. N87-21245
KUPPERMANN, ARON N87-21133
KWATNY, H. G. N87-21388
KWIATKOWSKI, J. J. N87-21164
KWON, JANG-HYUK N87-20963

L

LADHARI, F. N87-21296
LAFRAMBOISE, J. G. N87-21027
LAHEY, R. T., JR. N87-21287
LAHMEYER, CHARLES R. N87-21591
LAIRD, C. N87-21091
LAMB, R. C. N87-21842
LANGE, ANTTI A. N87-21479
LAROS, J. G. N87-21841
LARRABEE, R. D. N87-21368
LASSEN, K. N87-21446
LAUCHLE, G. C. N87-21268
LAUFFER, J. P. N87-21394
LAWRENCE, CHARLES N87-21375
LAWSON, M. O. N87-21278
LAZAREV, V. D. N87-21307
LEACH, EUGENE R. N87-21244
LEADER, D. R. N87-21740
LEAVERS, V. F. N87-21597
LEBEDEV, V. I. N87-21565
LEE, C. H. N87-21251
LEE, HYUNG MOK N87-21767
LEE, J. N87-21249
LEE, J. J. N87-21752
LEE, J. W. N87-21047
LEE, M. I. N87-21065
LEFTWICH, P. W. N87-21527
N87-21528
LEITH, C. E. N87-21284
LEONG, PATRICK J. N87-21246
LEROY, M. N87-21624
LESIEUTRE, DANIEL J. N87-21010
LESZAK, MAREK N87-21614
LEVI, D. N87-21633
N87-21634
LEVIN, ALAN D. N87-20990
LEVIN, B. C. N87-21169
LEVINE, J. N. N87-21038
LEVY, R. N87-21264
LEWIS, D. A. N87-21642
LEWIS, J. P. N87-21303
LEWIS, M. F. N87-21680
LEWIS, W. L, III N87-21619
LI, CHUN-SHENG N87-21793
N87-21819
LI, CHUNG-SHENG N87-21794
LI, CHUNSHENG N87-21805
LI, HONG-WEI N87-21819
LI, HONGWEI N87-21805
LI, XIAO-CONG N87-21809
LIEBE, H. J. N87-21209
LIGHT, GLENN C. N87-21062
LIHOU, MARTIN N87-21031
LIN, C. S. N87-21214
LIN, SHU N87-21625
LINGENFELTER, A. C. N87-21317
LIU, C. T. N87-21098
N87-21101
LIU, N.-S. N87-21693
LIU, YU-YING N87-21809
LIVIE, BRIAN K. N87-20979
LOBACHIK, V. I. N87-21562
LOCQUET, J. P. N87-21706
N87-21708
LOEVE, W. N87-21606
N87-21734
N87-21742
LOGAN, E. N87-21260
LOGRASSO, B. K. N87-21084
LOK, H. N87-21227
LOMBROZO, P. N87-21107
LONG, GABRIELLE G. N87-21089
LOPEZMELLADO, LUIS ERNESTO N87-21356
LORENTSEN, ROBERT N. N87-21220
LORIA, E. A. N87-21101
LOUCKS, C. S. N87-21353
LOWTHER, R. N87-21409
LOZIER, D. W. N87-21302
LUDEKE, RUDOLF N87-21691
LUNDIN, E. N87-21837
LUNDSTROM, M. S. N87-21416
LUSIGNOLI, M. N87-21666
LUYCKX, S. N87-21096
LYNCH, JAMES N87-21363

M

MACHADO, MARCOS E. N87-21812
MACOSKO, CHRISTOPHER W. N87-21115
MACY, D. N87-21682
MADDOX, P. N87-21273
MAEDA, M. N87-21355
MAETZLER, CHRISTIAN N87-21525
MAGNUSEN, P. E. N87-21085
MAGRE, PHILIPPE N87-21175
MAGUN, A. N87-21792
N87-21806
MAHRT, L. N87-21520
MAIANI, LUCIANO N87-21636
MAIMONI, A. N87-21252
MAIYA, P. S. N87-21099
MALEY, E. M. N87-21240
MALGUZZI, P. N87-21499
N87-21501
MALINOWSKI, SZYMON P. N87-21466
MALONE, R. M. N87-21682
MALONEY, RICHARD T. N87-21220
MALVERN, L. E. N87-21048
MALVEZZI, A. M. N87-21124
N87-21251
MARISKA, J. T. N87-21814
MARKIEWICZ, R. S. N87-21119
N87-21694
MARKLEY, DAVID R., JR. N87-21519
MARSHALL, G. L. N87-21114
MARTIN, A. S. R. N87-21162
MARTIN, BRUCE J. N87-21555
MARTIN, DAVID W. N87-21533
MARTIN, DONN CHRISTOPHER N87-21840
MARTIN, T. P. N87-21352
MARTINELLI, GUIDO N87-21636
MARTINEZ, D. R. N87-21395
MARTINEZ, L. N87-21106
MARULLO, S. N87-21497
MATHEWS, G. J. N87-21771
MATSUMOTO, JAMES H. N87-21062
MAUAS, PABLO J. N87-21812
MAUGHAN, JEFF N87-21034
MAUTZ, JOSEPH R. N87-21217
MAZZACURATI, V. N87-21071
N87-21721
N87-21722
MCCARTHY, J. N87-21750
MCCLEMENTS, K. G. N87-21825
MCCLURE, C. R. N87-21746
N87-21747
MCCOMAS, D. J. N87-21775
N87-21784
MCCONNELL, P. N87-21107
MCCOY, WILLIAM T. N87-21267
MCCUMME, JAMES E. N87-21341
MCDONALD, H. N87-21263
N87-21264
MCDONALD, K. L. N87-21531
MCFADDEN, P. D. N87-21003
MCGEE, OLIVER G. N87-21375
MCGINLEY, J. A. N87-21491
N87-21508
N87-21515
MCKAMEY, C. G. N87-21098
MCKIBBEN, BRUCE N. N87-21434
MCLAIN, K. K. N87-21362
MCNEIL, WILLIAM J. N87-21032
MCQUILLAN, P. N87-21820
MCWILLIAMS, B. M. N87-21320
MEARS, A. L. N87-21237
MEDKOVA, I. L. N87-21565
MEDLEY, H. W. N87-21749
MELE, B. N87-21672
MELLING, A. N87-21178
MELNIKOV, V. I. N87-21489
MENDENHALL, MICHAEL R. N87-21010
MENG, C.-I. N87-21446
MENZEL, W. P. N87-21496
MENZIES, DAVID N87-21535
MESEROLE, JERE S. N87-21146
N87-21149
MESINGER, FEDOR N87-21498
MESSIER, RUSSELL N87-21117
METCALFE, MARGEN H. N87-21589
MEYER, ROBERT R., JR. N87-20966
MEYN, LARRY A. N87-21006
MICHARD, M. N87-21294
MICHELASSI, V. N87-21297
N87-21298
MIGHELL, A. D. N87-21724
MIGRA, ROBERT P. N87-21153
MIKAELIAN, K. O. N87-21274
MILEY, D. V. N87-21100
MILLER, A. C. N87-21214
MILLER, BRIAN S. N87-21269
MILLER, JOHN N87-21034
MILLS, G. A. N87-21496
MILLS, GLEN N87-20991
MILLS, W. J. N87-21102
MILNER, K. R. N87-21602
MINARDI, J. E. N87-21278
MINKOVA, M. I. N87-21574
N87-21582
MINOR, J. E. N87-21113
MIRELS, HAROLD N87-21312
N87-21314
MISRA, M. N87-21053
MITCHELL, W. N87-21598
MITLITSKY, F. N87-21320
MITTRA, RAJ N87-21216
MIYAKODA, K. N87-21482
MOELLER, H. N87-21676
MONCUR, N. K. N87-21325
MOOERS, CHRISTOPHER N. N87-21541
N87-21542
N87-21544
MOORE, B. B. N87-21041
MOORE, WALT N87-21034
MOREAU, PIERRE N87-21175
MOREL, R. N87-21298
MORELAND, J. N87-21715
MORELLI, A. N87-21669
MORUKOV, B. V. N87-21563
MOUNTAIN, P. J. N87-21739
MOZGALA, MARLENE N87-20985
MRAZEK, R. V. N87-21733
MUELLER, JAMES L. N87-21535
MUNOZ, D. N87-21285
MUNSON, HAROLD E. N87-21342
MURCHIE, J. R. N87-21317
MYERS, D. R. N87-21703
MYGIND, J. N87-21700
MYLEN, L. N87-21227

N

NAGATANI, RONALD MITSUD N87-21423
NAGEM, RAYMOND J. N87-21030
NAKAJIMA, H. N87-21800
N87-21827
NAKANISHI, SHIGEO N87-21234
NARASIMHAN, R. N87-21384
NARDONE, M. N87-21071
NASH, P. J. N87-21305
NATARAJAN, B. K. N87-21626
NAUMANN, ROBERT J. N87-21111
NAZARIO, SUSANA M. N87-21010
NEEMAN, Y. N87-21648
NEILL, W. S. N87-21336
NEJJAR, JALAL N87-21718
NELANDER, A. N87-21227
NELSON, D. R. N87-21402
NELSON, DUANE A. N87-21039
NESMITH, MALCOLM F. N87-21333
NEUMAN, R. D. N87-21321
NEUPERT, WERNER M. N87-21816
NEWHOUSE, V. L. N87-21051
NEWMAN, R. K. N87-21278

NEWNAM, B. E. N87-21328
NGUYEN, T. N87-21212
N87-21213
NIAKI, S. N87-21168
NIBLETT, LL. T. N87-20988
N87-20989
N87-21000
NICHOLSON, J. H. N87-21203
NIEDZWIEDZ, TADEUSZ N87-21492
NIEL, M. N87-21790
NIES, HELMUT N87-21361
N87-21399
NIETO, M. M. N87-21725
NIKJOOY, MOHAMMAD N87-20996
NIKKEL, DANIEL J., JR. N87-21372
NINA, M. N. R. N87-21194
NIXON, DAVID N87-21585
NOLA, FRANK J. N87-21233
N87-21410
NOMOTO, K. N87-21773
NORDMAN, JAMES E. N87-21695
NORTHRUP, C. N87-21750
NORTON, WILLIAM J. N87-21001
NOVICK, ROBERT N87-21789
NUZHDIN, P. V. N87-21489

O

OBRIEN, LIAM P. N87-21407
OEBERG, TERO N87-21110
OEMRAW, B. N87-21523
OHKI, K. N87-21795
OKHOBOTOV, A. A. N87-21577
OLDFIELD, M. L. G. N87-21203
OLINER, ARTHUR A. N87-21247
OLSEN, R. C. N87-21024
OLSON, LAWRENCE E. N87-21006
OLSON, W. P. N87-21835
OMNES-CHEVALIER, MARIE-CHRISTINE N87-21226
ONTKO, NEAL R. N87-21086
OPPERMANN, H. V. N87-21452
ORIENT, OTTO J. N87-21660
N87-21661
OROURKE, P. J. N87-21344
ORTON, GEORGE N87-21157
ORWIG, L. E. N87-21813
ORWIG, LARRY E. N87-21785
N87-21799
OSCHINSKI, J. N87-21677
OSSEYRAN, ANWAR N87-21608
OTSUKA, H. N87-21696
OVSYANNIKOV, G. A. N87-21700
OWENS, LESTER J. N87-21755
OYOUNG, S. D. N87-21627
OZASLAN, KEMAL N87-21339

P

PAABO, M. N87-21169
PAK, HASONG N87-21535
PALADIN, G. N87-21639
PALADIN, GIOVANNI N87-21640
N87-21643
PANKOVA, A. S. N87-21569
PANTEV, T. P. N87-21574
N87-21582
PARAMESWARAN, T. N87-21174
PARDEE, R. J. N87-21751
PARISH, RICHARD C. N87-21152
PARK, J. Y. N87-21096
PARK, S. N87-21082
PARKER, JOHN A. N87-21112
PARKER, L. W. N87-21027
PASTRE, CLAUDE N87-21477
PATON, R. N87-21096
PATRICK, WILLIAM P. N87-21257
PATTERSON, D. E. N87-21529
PATTERSON, E. L. N87-21323
PAULTER, N. G. N87-21704
PAVLIN, ANTOINE N87-21717
PEALAT, MICHEL N87-21175
PEARCE, ROBERT N87-20991
PECHENKINA, R. A. N87-21567
PEERCY, P. S. N87-21318
N87-21703
PEET, SHELLY N87-21239
PELITI, L. N87-21402
N87-21638
N87-21639
PENG, SONG-TSUEN N87-21219
PENSO, G. N87-21668
PEREIRA, J. C. F. N87-21185
PEREPEZKO, J. H. N87-21318
PERKINS, GERALD S. N87-21304
PESNELL, W. D. N87-21774
PESSA, MARKUS N87-21692
PETERSON, LEE D. N87-21147
PETRARCA, S. N87-21668
PETRIDIS, DIMITRIOS M. N87-21365
PETROSSIANTS, M. A. N87-21484
PFITZER, K. A. N87-21835
PHAM, H. L. N87-21505
PICART, ALAIN N87-21289
PICHLER, H. N87-21506
PICK, M. N87-21792
PICKARD, J. M. N87-21390
PICKERING, H. W. N87-21081
PICONE, J. M. N87-21266
PICRAUX, S. T. N87-21703
PIERREHUMBERT, RAYMOND T. N87-21496
PIGEAUD, A. N87-21414
PINDERA, MACIEJ ZENON N87-21058
PITA, G. P. A. N87-21194
PITOLLI, F. N87-21672
PITTMAN, E. S. N87-21715
PITTS, WILLIAM C. N87-21011
PLETCHER, R. H. N87-21303
POESCHEL, R. L. N87-21163
POLAND, A. I. N87-21814
POLYAKOV, A. N. N87-21568
PONGRATZ, M. B. N87-21440
POPLE, A. J. N87-21005
POPOV, S. S. N87-21307
POPOWICZ, ZIEMOWIT N87-21632
PORTAT, M. N87-21195
POST, D. N87-21196
POSTLETHWAITE, I. N87-21627
POTTER, R. T. N87-21045
POULTNER, N. D. N87-21592
POUND, E. F. N87-20987
PRAHARAJ, SARAT C. N87-21012
N87-21013
N87-21014
PRICE, K. N87-21212
N87-21213
PRINN, RONALD G. N87-21428
PRZYBYLSKI, K. N87-21095
PUGLIESE, A. N87-21666
PURDOM, JAMES FRANCIS WHITEHURST N87-21424

Q

QUATE, C. F. N87-21062
N87-21662

R

RABUSHKA, A. I. N87-21532
RAJU, I. S. N87-21377
RALSTON, JOE N87-21034
RAMATY, REUVEN N87-21823
RAMINS, PETER N87-21239
RAMIS, C. N87-21510
RAO, DESIRAJU B. N87-21534
RAO, J. B. N87-21218
RAPP, RICHARD H. N87-21431
RAWAL, S. N87-21053
RAYMER, M. G. N87-21319
REDDY, J. N. N87-21379
REDGRAVE, F. N87-21305
REES, N. J. M. N87-21258
REGINATO, L. N87-21642
REHM, R. G. N87-21302
REICHMUTH, J. N87-21205
REIMER, E. N87-21509
REINHARDT, MANFRED E. N87-21455
N87-21459
REITSEMA, H. J. N87-21782
RENAUD, PHILIP G. N87-21545
REYNOLDS, G. H. N87-21042
REZNIK, P. L. N87-21113
RHINE, WENDELL E. N87-21121
RHODERICK, G. C. N87-21074
RICCI, M. A. N87-21071
RICHARDSON, JENNIFER N87-21034
RICHNER, H. N87-21494
RICHNER, HANS N87-21488
N87-21493
RIEMER, DAVID H. N87-21144
RIENSTRA, S. W. N87-21656
RILEY, J. P. N87-21659
ROBERTS, B. N87-21822
ROBERTS, R. A. N87-21367
ROCK, K. N87-21837
ROGACHEVA, I. V. N87-21568
ROGERS, D. N87-21642
ROJEK, FREDRIC W. N87-21004
ROLLETT, A. D. N87-21094
ROMAN, GRUIA-CATALIN N87-21406
ROSAKIS, A. J. N87-21384
ROSEN, B. R. N87-21123
ROSEN, D. N87-21315
ROSENBLAT, S. N87-21282
ROSIER, B. N87-21201
ROSS, JAMES C. N87-21006
ROSSI, GIANCARLO N87-21638
ROTHE, SABINE N87-21607
ROUSSEL-DUPRE, R. A. N87-21440
N87-21666
ROY, S. N87-21379
RUBIN, JAMES B. N87-21131
RUFF, PAUL E. N87-21060
RUIZ, C. N87-21196
RUMBLE, J. N87-21750
RUMYANTSEV, V. V. N87-21579
RUOCCO, G. N87-21071
N87-21721
N87-21722
RUTHER, W. E. N87-21099
RUTLEDGE, SHARON K. N87-21160
RYAN, J. M. N87-21826

S

SABA, J. L. R. N87-21815
SAH, C. TANG N87-21411
SAKAI, J. N87-21827
SAKHAROVA, Z. F. N87-21566
SALDEN, D. N87-21188
SALIK, J. N87-21078
SAMLIN, G. E. N87-21323
SAMPAIO, R. N87-21277
SAMPOLI, M. N87-21071
SAMUELS, D. E. J. N87-21258
SANCHEZ, BRAULIO V. N87-21534
SANDAHL, INGRID N87-21444
SANDER, HARRO N87-21387
SANDOR, BELA I. N87-21383
SANKUR, H. N87-21313
SANTINI, P. M. N87-21644
N87-21645
SAWCHUK, R. A. N87-21174
SCARF, F. L. N87-21784
SCARPELLI, AUGUST R. N87-21234
SCHEIFLER, ROBERT W. N87-21604
SCHELLEKENS, PETRUS HENRICUS JOHANNES N87-21331
SCHENK, R. U. N87-21167
SCHEPKIN, M. N87-21673
SCHILLING, DONALD L. N87-21222
SCHMID, A. N87-21324
SCHMID, K. C. N87-21383
SCHMIDT, H. U. N87-21782
N87-21783
SCHMIDT, JILL M. N87-21518
SCHMIDT, RITA N87-21628
SCHMUESER, P. N87-21676
SCHNEIBEL, J. H. N87-21108
SCHNEIDER, J. W. N87-21125
SCHODL, R. N87-21177
N87-21182
SCHOFIELD, W. H. N87-21260
SCHREINER, A. J. N87-21496
SCHUITMAN, ADRIANUS N87-21629
SCHULER, T. F. N87-21346
SCHULLER, I. K. N87-21706
N87-21708
SCHULTEN, J. B. H. M. N87-21657
SCHULTHEISZ, C. N87-21382
SCHULZ, R. B. N87-21122
SCHUSTER, JOHN R. N87-21143
SCHUTT, J. A. N87-21260
SCHWARTZ, R. J. N87-21416
SCHWARTZ, RICHARD A. N87-21796
SCHWENK-FERRERO, ALEKSANDRA N87-21665
SCOTT, JAMES N. N87-21271
SCRIVENER, C. T. J. N87-21203
SEARCY, A. W. N87-21392
SEASHOLTZ, RICHARD G. N87-21183
SECAN, JAMES A. N87-21430
SEEGMILLER, HENRY L. B. N87-21255
SEILER, MILTON R. N87-21244
SEMENOV, V. YU. N87-21563
SEVENHANS, W. N87-21706
N87-21708
SEVESTRE, CLAUDE N87-20974
SHACK, W. J. N87-21099
SHAH, C. N87-21050
SHANK, ERIC M. N87-21603
SHARMA, SURENDRA P. N87-20965
SHARP, R. SCOTT N87-21015
N87-21016
N87-21017

SHAW, B. J. N87-21092
SHAW, M. J. N87-21329
SHAY, H. D. N87-21330
SHCHECHKIN, I. YE. N87-21572
SHEEHAN, ROBERT E. N87-21436
SHEIKHOLESLAMI, MOHAMAD ZAHED N87-21256
SHER, A. N87-21066
SHIEH, LEANG S. N87-21615
SHAHMED, NORA N87-21357
SIEBERT, L. D. N87-21325
SIGNORELLI, G. N87-21721
SIGNORELLI, JOEL N87-21381
SIGNORINI, C. N87-21678
SIKKA, V. K. N87-21101
SIME, D. G. N87-21837
SIMNETT, G. F. N87-21797
SIMON, R. S. N87-21758
SINDORF, J. N87-21250
SINGER, HOWARD J. N87-21032
SINGH, P. N87-21414
SIRENKO, S. P. N87-21572
SITNIKOV, I. G. N87-21484
SKUDRIDAKIS, JEAN N87-21468
SLABY, JACK G. N87-21756
SLAVIN, J. A. N87-21775
N87-21784
SLINN, SUZANNE Y. N87-20978
SMAGORINSKY, JOSEPH N87-21472
SMALLWOOD, D. O. N87-21394
SMALLWOOD, G. J. N87-21174
SMALLWOOD, GREGORY J. N87-21336
SMIRNOV, K. V. N87-21565
N87-21567
SMIRNOVA, T. M. N87-21562
SMIT, D. J. N87-21728
SMITH, BRAD N87-21034
SMITH, CALDWELL P. N87-21221
SMITH, D. N87-21062
SMITH, DEAN F. N87-21828
SMITH, E. J. N87-21775
N87-21784
SMITH, PETER M. N87-21537
SMITH, RONALD C. N87-20990
SMITH, S. L. N87-21548
SMITH, W. L. N87-21496
SNELLING, D. R. N87-21174
SNELLING, DAVID R. N87-21336
SO, RONALD M. C. N87-20996
SOMMER, DAVID L. N87-21246
SOPPET, W. K. N87-21099
SOROKINA, YE. I. N87-21577
SOUZA, PAULO R. N87-21616
SPAEPEN, FRANS N87-21087
SPECK, J. N87-21124
SPENCER, J. H. N87-21758
SPERANZA, A. N87-21499
N87-21500
SPETH, P. N87-21512
SPEZIALE, C. G. N87-21259
STAEHLI, M. N87-21806
STALENHOEF, A. H. C. N87-20986
STALICK, J. K. N87-21724
STANISLAS, MICHEL N87-21309
STANLEY, M. N87-21600
N87-21601
STARR, G. P. N87-21353
STARR, J. N87-21168
STARRETT, H. S. N87-21086
STARRFIELD, S. N87-21772
STARRFIELD, S. G. N87-21774
STARRFIELD, SUMNER N87-21765
START, G. E. N87-20987
STECKEL, G. L. N87-21046
STEEDEN, R. V. N87-21192
STEELE, J. P. H. N87-21353
STEENROD, STEPHEN D. N87-21534
STEIN-SCHABES, J. A. N87-21779
STEINACKER, H. N87-21490
N87-21506
STEINBECK, J. N87-21124
STEINBERG, J. L. N87-21775
N87-21784
STEINBERG, MORRIS A. N87-20957
N87-20958
N87-20959
N87-20960
STEINFELD, MARTINA N87-21628
STELLATO, JOANNE M. N87-21241
STEPHENS, JOSEPH R. N87-21077
STEVENSON, D. A. N87-21690
STEWART, ERIC C. N87-20999
STEWART, P. A. E. N87-21198
STIENEKE, C. K. N87-21418
STIRLING, K. Q. N87-21136
STOCKEL, JAMES A. N87-21535
STRAZISAR, ANTHONY J. N87-21176
STRICKER, W. N87-21171
STRINATI, G. N87-21674
STRONG, K. T. N87-21815
STRUTH, ROBERT G., JR. N87-21026
STUNDER, B. J.B. N87-21418
STUPAKOV, G. P. N87-21566
STURROCK, PETER A. N87-21786
N87-21838
SU, A. N87-21063
SUDLOW, I. N87-21306
SUME, AIN N87-21525
SUN, C. T. N87-21046
SUNDSTROM, E. N87-21355
SURESH, S. N87-21398
SVENSMARK, H. N87-21700

T

TACX, JACOBUS CHRISTINUS JOSEPHUS F. N87-21127
TAFFERNER, A. N87-21504
TAJIMA, T. N87-21327
N87-21827
TAKAKURA, T. N87-21803
TAKEWAKI, HIDEAKI N87-21631
TALON, R. N87-21790
TAMPIERI, F. N87-21514
TAN, CHOON S. N87-21341
TANAKA, DENIOL N87-21089
TAPPING, K. F. N87-21803
N87-21807
N87-21829
TARASOV, V. S. N87-21307
TARDOV, V. M. N87-21577
TASSY, ALAIN N87-21225
TAYLOR, J. K. N87-21452
TAYLOR, R. M. N87-21619
TEGART, JAMES N87-21158
TELIONIS, D. P. N87-21276
TEPPER, MORRIS N87-21473
TERELJAK, JAN N87-21578
TESTA, MASSIMO N87-21636
TEWARSON, A. N87-21072
THELIN, BO N87-21445
THEOBALD, A. G. N87-21647
THOMAS, G. N87-21093
THOMAS, ROGER J. N87-21816
THOMPSON, WILLIAM T. N87-21816
TIBALDI, S. N87-21500
N87-21503
N87-21513
TICHENOR, D. A. N87-21186
TIEGS, T. N. N87-21052
TIELENS, A. G. G. M. N87-21075
N87-21780
TIGRANYAN, R. A. N87-21580
N87-21581
TIMMERMANS, J. N87-21310
TIONG, K. K. N87-21245
TOSI, E. N87-21500
TRACEY, KAREN L. N87-21543
TRANQUADA, J. M. N87-21702
TREE, IHO KUO N87-20964
TREVISAN, A. N87-21499
N87-21501
TRIMBLE, D. N87-21642
TRINUS, K. F. N87-21571
TRIPOLI, GREGORY JOHN N87-21425
TRYON, P. V. N87-21641
TSANG, S. N87-21347
TUCKER, M. D. N87-21394
TUEGEL, E. J. N87-21116
TUREK, ROBERT S. N87-21433
TURNER, A. N87-21212
N87-21213
TURNER, M. S. N87-21778
TYDINGS, JOHN N87-21090

U

UDO, F. N87-21310
UNGSUWARUNGSRI, T. N87-21382
UNY, GENEVIEVE N87-21290

V

VAICAITIS, RIMAS N87-21652
VAIDYANATHAN, H. N87-21250
VAKULINA, O. P. N87-21581
VALENZUELA, A. N87-21440
VANAKEN, JOHANNES M. N87-21006
VANDENBERG, J. I. N87-21292
VANDERHORST, J. N87-21522
VANDERPUTTEN, ANDREAS MARTINUS T. P. N87-21070
VANDRANEN, W. H. N87-21743
VANHEDEL, H. J. N87-21741
VANHOLTEN, J. W. N87-21726
N87-21727
VANNUCCI, ITALO N87-21595
VANNUCCI, RAYMOND D. N87-21043
VANSCHILFGAARDE, M. N87-21088
VARMA, ASHA N87-21060
VASILYEV, V. K. N87-21575
N87-21576
VEATCH, MICHAEL H. N87-20995
VEDRENNE, G. N87-21790
VERBRUGGEN, MARCEL LEONA CLEMENTINE EDUARD N87-21056
N87-21057
VERENINOV, I. A. N87-21307
VILNROTTER, VICTOR A. N87-21207
VILPAS, MARTTI N87-21361
N87-21399
VINET, PASCAL N87-21069
VIOLA, A. N87-21497
VLAHOS, LOUKAS N87-21830
VOERSMANN, PETER N87-21469
VOGELSONG, RONALD N87-21243
VOLOZHIN, A. I. N87-21568
VONOHAIN, H. P. N87-21278
VU, LOC QUOC N87-21335
VULPIANI, A. N87-21639
N87-21732
VULPIANI, ANGELO N87-21643
VYADRO, M. D. N87-21559

W

WADE, D. J. N87-21739
WAGENER, RICHARD N87-21762
WAGNER, M. N87-21191
WALLACE, R. N87-21190
WALLIN, KIM N87-21110
WALSH, DONALD E. N87-21753
WALTERS, E. J. N87-21748
WALTERS, R. R. N87-21390
WANG, P.-H. N87-21429
WANG, SHU-LAN N87-21809
WANG, YU N87-21337
WARD, ALFORD L. N87-21241
WARD, C. R. N87-21346
WARHAM, A. G. P. N87-21369
WARMBROD, JOHN D. N87-21012
N87-21013
N87-21014
WASEL, ROBERT A. N87-21037
WATT, R. G. N87-21326
WATTENDORF, F. L. N87-21278
WATTS, D. R. N87-21543
WEBB, P. H. N87-21196
WEBB, W. E. N87-21723
WEBBER, S. E. N87-21137
WEGMAN, R. N87-21783
WEILER, K. W. N87-21758
WEINACHT, P. N87-21301
WEIR, T. E. N87-21737
WEISBIN, C. R. N87-21345
N87-21350
N87-21354
WELLS, G. D. N87-21808
WEST, C. L. N87-21680
WESTBROOK, J. N87-21750
WESTRICH, C. N. N87-21317
WEY, CHOWEN CHOU N87-21404
WEYANDT, C. N87-21212
N87-21213
WHANG, M. H. N87-21245
WHEATLEY, J. N87-21275
WHERRY, R. J., JR. N87-21588
WHIPPLE, F. L. N87-21782
WHITCHER, F. S. E. N87-21192
WHITE, C. L. N87-21097
WHITE, J. M. N87-21137
WHITE, N. J. N87-21654
WHITEHEAD, J. C. N87-21320
WHITELAW, J. H. N87-21184
WHITLEY, PHILIP E. N87-21587
WHITTAKER, J. N87-21393
WHITTMANN, PAUL A. N87-21542
WIERINGA, J. N87-21524
WIKLANDER, DAG N87-20994
WILHELM, K. N87-21782
WILL, CLIFFORD M. N87-20984
WILLEKE, HERMANN N87-21458
WILLIAMS, G. N87-21064
WILLIAMS, J. M. N87-21405
WILLIAMS, JAMES H., JR. N87-21030

WILLIAMS, L. N87-20997
WILLIAMS, M. CARLSON N87-21181
WILLIAMS, NEAL N87-21034
WILSON, CHARLES R. N87-21434
WILSON, J. R. N87-21771
WILSON, M. F. N87-21530
WINCH, P. C. N87-21130
WINGLEE, R. M. N87-21821
WISMANS, J. S. H. M. N87-21553
N87-21557
WITTMAN, PAUL A. N87-21544
WITTMANN, PAUL A. N87-21541
WOLF, D. N87-21707
N87-21710
WOLFE, JAMES F. N87-21120
WONG, DAVID C. N87-21413
WOOD, L. L. N87-21757
WOOD, M. A. N87-21210
N87-21211
WOOD, RICHARD D. N87-20990
WOODEN, WILLIAM H. N87-20983
WOODGATE, B. E. N87-21813
WOOH, S. C. N87-21047
WORKMAN, GARY L. N87-21140
WORSFOLD, WINIFRED E. N87-21258
WOYTOWITZ, PETER J. N87-21378
WU, J. C. N87-20971
WU, X. S. N87-21681
WUELSER, J-P. N87-21817
WYSS, J. C. N87-21658

X

XU, T. S. N87-21063

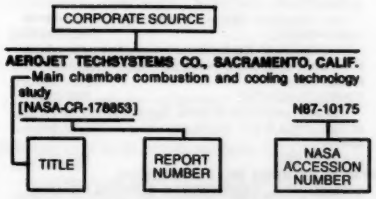
Y

YABE, TAKASHI N87-21631
YANG, L. N87-21042
YASHAN, D. N87-21347
YASUKAWA, E. N87-21837
YATES, E. CARSON, JR. N87-21376
YEH, T. T. N87-21139
YEUNG, HUBERT K. N87-21030
YODER, J. A. N87-21547
YOST, WILLIAM T. N87-21653
YOUNG, ROBERT J. N87-21049
YUE, G. K. N87-21429
YUH, C. Y. N87-21414
YUREK, G. J. N87-21095

Z

ZACH, R. N87-21590
ZAIDMAN, E. N87-21827
ZAITSEVA, N. A. N87-21480
ZAKHAROVA, T. S. N87-21563
ZANG, T. A. N87-21259
ZANG, THOMAS A. N87-20968
ZANGRANDO, F. N87-21285
ZANI, A. C. N87-21551
ZARITSKIY, V. V. N87-21570
ZARRO, D. M. N87-21815
ZHAO, REN-YANG N87-21809
ZHENG, LE-PING N87-21809
ZHIDKOV, V. V. N87-21562
ZHIZNEVSKAYA, O. V. N87-21565
ZHUKOV, A. K. N87-21575
ZIELINSKI, W. L. N87-21074
ZINN, B. T. N87-21063
ZODIVAZ, A. M. N87-21802
N87-21803
ZONG-WU, YUE N87-21684
ZONJEE, N. N87-21310
ZORINA, N. G. N87-21575
N87-21576

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The NASA accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ACADEMY OF SCIENCES OF THE UKRAINIAN SSR, KIEV.
On the mass loss rate by the nuclei of planetary nebulae
[DE87-701325] N87-21777

ADMIRALTY RESEARCH ESTABLISHMENT, PORTLAND (ENGLAND).
Introduction to MASCOT 3
[ARE-TM(UDP)-86102] N87-21598
On the numerical modelling of a magnetic source
[ARE-TR-86113] N87-21647

ADMIRALTY RESEARCH ESTABLISHMENT, TEDDINGTON (ENGLAND).
Test of FORTRAN program for sound scattering by layered sphere
[ARE-TM(UHA)-86518] N87-21654

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, NEUILLY-SUR-SEINE (FRANCE).
Advanced Instrumentation for Aero Engine Components
[AGARD-CP-399] N87-21170
How to select a laser velocimeter for a given application? N87-21179

AERONAUTICAL RESEARCH INST. OF SWEDEN, STOCKHOLM.
Development of optimization system OPTSYS: Implementation of static aeroelastic constraints
[FFA-TN-1986-40] N87-20994
Fatigue crack growth under cyclic compression: Role of first load cycle
[FFA-TN-1986-71] N87-21398
Self-adaptive Finite Element (FE) analysis of solid structures. Part 1: Element formulation and a posteriori error estimation
[FFA-TN-1986-27] N87-21400
Finite element analysis of three-dimensional structures using adaptive p-extensions
[FFA-TN-1986-57] N87-21401

AERONAUTICAL RESEARCH LABS., MELBOURNE (AUSTRALIA).
State constraints for predictive control with air vehicle application
[AD-A176205] N87-21002
Analysis of vibration data from WHL (Westland Helicopters Limited) Wessex fatigue test trial 3
[AD-A176208] N87-21003
Viscous flow around wall mounted obstacles
[ARL-AERO-PROP-REPT-172] N87-21260

AEROSPACE CORP., EL SEGUNDO, CALIF.
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft
[AD-A176815] N87-21024
Compressive properties and laser absorptivity of unidirectional metal matrix composites
[AD-A176194] N87-21046
Kinetics of some gas phase elementary reactions of boron monofluoride
[AD-A167690] N87-21062
Test methodology for adaptive antenna systems
[AD-A176295] N87-21215
Performance of two coupled lasers
[AD-A177185] N87-21312
Saturation effects in coupled lasers with homogeneous gain
[AD-A176843] N87-21314

AEROSPACE CORP., LOS ANGELES, CALIF.
Direct Monte Carlo simulation of small bipropellant engine plumes
[AD-A177079] N87-21039

AEROSPACE STRUCTURES INFORMATION AND ANALYSIS CENTER, WRIGHT-PATTERSON AFB, OHIO.
A two-dimensional linear elastic crack tip element for NASTRAN
[AD-A176133] N87-21378

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.
Experimental studies on the dynamic development and control of unsteady separated flows
[AD-A176376] N87-20969
Selection of packet switched facilities for the search and rescue communications network based on performance
[AD-A176554] N87-20979
Satellites and developing countries: Purpose, problems, and progress
[AD-A176538] N87-21022
The fundamentals of timing and synchronization for digital communication networks
[AD-A176721] N87-21220
Normal wave propagation velocity in a static web
[AD-A176539] N87-21380
Wave propagation in periodic truss structures
[AD-A176548] N87-21381
Multispectral analysis of a tropical radiance set from the TIROS operational vertical sounder
[AD-A176578] N87-21432
An analysis of upper atmospheric parameters derived from the observation of meteor echoes by a 2.66 MHz radar
[AD-A176662] N87-21433
Thunderstorm influence on boundary layer winds
[AD-A176543] N87-21518
The effect of altered levels of carbon dioxide on the incidence of altitude decompression sickness
[AD-A176558] N87-21556
Present and future military uses of outer space: International law, politics, and the practice of states
[AD-A176722] N87-21753
Pick-up ion trajectories in a comet model
[AD-A176618] N87-21770

AIR FORCE ROCKET PROPULSION LAB., EDWARDS AFB, CALIF.
Acoustic-mean flow interactions
[AD-A176845] N87-21038

AIR FORCE SYSTEMS COMMAND, WRIGHT-PATTERSON AFB, OHIO.
Communication systems through artificial Earth satellites (selected pages)
[AD-A176940] N87-21028

AIR FORCE WRIGHT AERONAUTICAL LABS., WRIGHT-PATTERSON AFB, OHIO.
Mechanical properties of elementally blended Ti-6Al-4V
[AD-A176640] N87-21086
Compressor blade clearance measurement using capacitance and phase lock techniques N87-21200
Quantitative Feedback Theory (QFT): Technique for designing multivariable control systems
[AD-A176883] N87-21617

ALABAMA UNIV., HUNTSVILLE.
Fiber glass pulling
[NASA-CR-179036] N87-21140

ALASKA UNIV., FAIRBANKS.
Antarctic atmospheric infrasound
[AD-A176804] N87-21434

ALL-UNION SCIENTIFIC RESEARCH INST. OF HYDROMETEOROLOGICAL INFORMATION, MOSCOW (USSR).
The Mediterranean-Alpine Experiment (MED-ALPEX) data set N87-21489

ALLIED BENDIX AEROSPACE, KANSAS CITY, MO.
Fabrication of open cell epoxy foam
[DE87-006186] N87-21125

ALLIED BENDIX AEROSPACE, UTICA, N.Y.
Investigation and design of a high efficiency turbine wheel
[AD-A176191] N87-20997

ANACAPA SCIENCES, INC., FORT RUCKER, ALA.
Human factors research in aircrew performance and training
[AD-A176099] N87-21586

ANALYTIC SCIENCES CORP., READING, MASS.
Fault-tolerant system analysis: Imperfect switching and maintenance
[AD-A176514] N87-20995
Reliability growth prediction
[AD-A176128] N87-21362

ANALYTICS, INC., WILLOW GROVE, PA.
Theoretical development for identifying underlying internal processes. Volume 1. The theory of underlying internal processes
[AD-A176466] N87-21588

APPLIED RESEARCH CORP., LANDOVER, MD.
Rapid soft X-ray fluctuations in solar flares observed with the X-ray polychromator N87-21815

APPLIED RESEARCH LAB., STATE COLLEGE, PA.
Wavevector-frequency spectrum of transition zone wall pressure fluctuations
[AD-A176655] N87-21266

ARCO SOLAR, INC., CHATSWORTH, CALIF.
Pulsed excimer laser processing for cost-effective solar cells
[NASA-CR-180528] N87-21413

ARGONNE NATIONAL LAB., ILL.
Technical basis for normal water chemistry guidlines:: Review of laboratory studies of water chemistry effects on SCC (Stress Corrosion Cracking)
[DE87-004701] N87-21099
Development of nuclear magnetic resonance imaging techniques for characterizing green-state ceramic materials
[DE87-004987] N87-21123
Proceedings of the International Workshop on High-Temperature Molten Salt Batteries
[DE87-003297] N87-21248
Battery thermal modeling: The methodology and applications
[DE87-004865] N87-21249
Ultrasonic NDE of green-state ceramic using focused through-transmission
[DE87-001494] N87-21367
Nature of coupling and dimensional crossover in superconducting multilayers
[DE87-004876] N87-21706
Computer simulation of special grain boundaries in metals and ionic materials
[DE87-004989] N87-21707
Superconducting properties of compositionally modulated Pb/Ge thin films
[DE87-004879] N87-21708
Grain-boundary modeling
[DE87-004737] N87-21710

ARIZONA STATE UNIV., TEMPE.
On the modelling of non-reactive and reactive turbulent combustor flows
[NASA-CR-4041] N87-20996

ARIZONA UNIV., TUCSON.
Artificially structured superconductors
[DE87-004007] N87-21714

ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).
The Aircraft to Satellite Data Relay: ASDAR N87-21478

ATOMIC ENERGY OF CANADA LTD., PINAWA (MANITOBA).
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[DE86-900117] N87-21590
ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON (ENGLAND).
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[AWRE-O-9/86] N87-21258
AUBURN UNIV., ALA.
Laser light-scattering and laser fluorescence studies of solvent extraction systems
[DE87-003910] N87-21321

B

BALL AEROSPACE SYSTEMS DIV., BOULDER, COLO.
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
BATTELLE COLUMBUS LABS., OHIO.
Effect of manufacturing processes on structural allowables
[AD-A176232] N87-21080
Studies of millimeter-wave diffraction devices and materials. Phase 3
[AD-A176917] N87-21244
BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WASH.
Two-phase reduced gravity experiments for a space reactor design N87-21154
BEECH AIRCRAFT CORP., BOULDER, COLO.
Space station experiment definition: Long term cryogenic fluid storage N87-21144
BELGRADE UNIV. (YUGOSLAVIA).
Alpine lee cyclogenesis: Numerical simulation and theory N87-21498
BERKELEY RESEARCH ASSOCIATES, INC., CALIF.
Thermal waves or beam heating in the 1960, November 5 flare N87-21828
BERN UNIV. (SWITZERLAND).
The microwave spectrum of solar millisecond spikes N87-21806
Rapid changes in H alpha-flares correlated with microwaves N87-21817
BHABHA ATOMIC RESEARCH CENTRE, BOMBAY (INDIA).
Pool type liquid helium cryopump
[DE87-701268] N87-21349
BJORKSTEN RESEARCH LABS., INC., MADISON, WIS.
Ice-melting characteristics of calcium magnesium acetate
[PB87-122123] N87-21167
BOEING AEROSPACE CO., KENT, WASH.
Mixing-induced fluid destratification and ullage condensation N87-21149
BOEING AEROSPACE CO., SEATTLE, WASH.
Overview: Fluid acquisition and transfer N87-21146
BOEING MILITARY AIRPLANE DEVELOPMENT, SEATTLE, WASH.
Fault tolerant electrical power system. Phase 1: Study
[AD-A177061-PH-1] N87-21246
BONN UNIV. (WEST GERMANY).
Synoptic 3D energy budgets during Alpine Experiment Special Observing Period (ALPEX-SOP) N87-21511
BOSTON COLL., CHESTNUT HILL, MASS.
Model results with PIIE (Polar Ionospheric Irregularities Experiment) rocket data
[AD-A176999] N87-21436
BRIGHAM YOUNG UNIV., PROVO, UTAH.
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE87-004004] N87-21065
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[PB87-126645] N87-21073
BRITISH BROADCASTING CORP., LONDON (ENGLAND).
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[BBC-RD-1987/2] N87-21208
BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Is the Somali Current a biological river in the Northwestern Indian Ocean
[DE87-003233] N87-21548
The acceptance of the SSC (Superconducting Supercollider) clustered lattice
[DE87-004177] N87-21697
Determination of the linear aperture of the SSC (Superconducting Supercollider) clustered lattice used for the conceptual design report
[DE87-004179] N87-21698
Basic ideas in the theory of organic conductors
[DE87-003209] N87-21699
EXAFS studies of grain boundary diffusion and segregation
[DE87-003435] N87-21702
White dwarf models of supernovae and cataclysmic variables
[DE87-004172] N87-21773
BUNDESANSTALT FUER MATERIALPRUEFUNG, BERLIN (WEST GERMANY).
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[AD-A177103] N87-21387
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C

CALIFORNIA INST. OF TECH., PASADENA.
Tetrahydrogen
[AD-A176778] N87-21133
An experimental and analytical program to develop crack tip fracture criteria
[AD-A176853] N87-21382
A finite element analysis of small-scale yielding near a stationary crack under plane stress
[AD-A177011] N87-21384
CALIFORNIA UNIV., BERKELEY.
On the aerodynamics of flames N87-21058
Design of dual phase steels for bars and rods
[DE87-003535] N87-21093
Design of low carbon dual-phase steels for high strength wire
[DE87-006169] N87-21104
Dynamics of flexible structures performing large overall motions: A geometrically-nonlinear approach N87-21335
Strain and stress cycling in elastic-plastic materials N87-21372
Astronomical observations of the 807 GHz CO J = 7-6 rotational line with a new heterodyne spectrometer N87-21759
Laser microprobe studies of rare gas isotopes in meteorites N87-21769
The physical origins of the cosmic ultraviolet background N87-21840
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Design of dual phase steels for bars and rods
[DE87-003535] N87-21093
Origin of cracking phenomena observed in decomposition reactions
[DE87-000199] N87-21392
Period three generation on microwave-induced constant-voltage steps of Josephson tunnel junctions
[DE87-003530] N87-21700
Field effect and Josephson junction
[DE87-004473] N87-21701
Materials Information for Science and Technology (MIST): Project overview
[PB87-136677] N87-21750
CALIFORNIA UNIV., IRVINE.
Impulsive phase solar flare X-ray polarimetry N87-21789
CALIFORNIA UNIV., LOS ANGELES.
Research on thermophysical properties of materials
[DE87-005682] N87-21064
Intelligent operating systems for autonomous robots: Real-time capabilities on a hypercube super-computer
[DE87-004076] N87-21620
Electron-cyclotron maser emission during flares: Emission in various modes and temporal variations N87-21821
CALIFORNIA UNIV., SAN DIEGO.
The hard X-ray to low energy Gamma-Ray spectrum of the crab nebula N87-21761
The sensitivity of H alpha profiles to rapid electron beam fluctuations N87-21810
CALIFORNIA UNIV., SAN DIEGO, LA JOLLA.
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784
CALIFORNIA UNIV., SANTA BARBARA.
Use of depletion-edge translation for high speed modulation and switching of lightwaves: Year-1
[AD-A176839] N87-21681
CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
On impact dynamics of robotic operations
[AD-A176464] N87-21337
Three-dimensional sensing and interpretation
[AD-A176906] N87-21340
On learning boolean functions
[AD-A176516] N87-21626
CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO.
Size and shape of solid fuel diffusion flames in very low speed flows
[NASA-CR-179576] N87-21129
CENTRE D'ESSAIS AERONAUTIQUE TOULOUSE (FRANCE).
Preimpregnated T5A-145-12-F584 carbon/epoxy from Hexcel-Genin: Elementary characterization
[PV-M5-517700] N87-21126
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, TOULOUSE (FRANCE).
Task execution control in assembly robot workcells
[LAAS-86-335] N87-21356
Contribution to the implementation of dynamic vision in the three-dimensional perception system of the HILARE robot
[CNRS-ORDER-959] N87-21357
Transport properties of GaAs. Contribution to the study of GaAs/(Ca,Sr)F2 structures using molecular beam epitaxy
[LAAS-86-330] N87-21718
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, VERRIERES-LE BUISSON (FRANCE).
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[ETN-87-99365] N87-21441
Activities report in aeronomy
[ETN-87-99366] N87-21442
CHASE (DAVID M.), INC., BOSTON, MASS.
Modeling turbulence-induced noise with application to noise control
[AD-A176417] N87-21655
CHESAPEAKE RESEARCH CONSORTIUM, INC., GLOUCESTER POINT, VA.
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[PB87-129458] N87-21531
CHICAGO UNIV., ILL.
Inflation in the universe, Circa 1986
[DE87-005399] N87-21778
CITY COLL. OF THE CITY UNIV. OF NEW YORK.
Communications using channels formed by meteor bursts
[AD-A176994] N87-21222
CIVIL AVIATION AUTHORITY, LONDON (ENGLAND).
Light aircraft maintenance. General guidance on implementation of the Light Aircraft Maintenance Scheme (LAMS), for aircraft not exceeding 2730 kg MTWA, with a certificate of airworthiness in the transport, aerial work or private category
[CAP-520] N87-20954
Ground de-icing of aircraft
[CAP-512] N87-20975
Extended Range Twin Operations (ETOPS)
[CAP-513] N87-20976
Ground Proximity Warning System (GPWS): Guidance material
[CAP-516] N87-20977
Objective testing for the pilot's instrument rating. Specimen examination material: Flight planning and navigation procedures, flight instruments and radio aids, meteorology, aviation law, flight rules and procedures
[CAP-519] N87-21583
COLOGNE UNIV. (WEST GERMANY).
Comparative study of several cases of Alpine lee-cyclogenesis: Kinetic energy and vorticity N87-21512
COLORADO STATE UNIV., FORT COLLINS.
Convective scale interaction: Arc cloud lines and the development and evolution of deep convection N87-21424
A numerical investigation of an orogenic mesoscale convective system N87-21425
COLORADO UNIV., BOULDER.
Thermal waves or beam heating in the 1960, November 5 flare N87-21828
COLUMBIA UNIV., NEW YORK.
A CO survey of the dark nebulae in Taurus and Perseus N87-21760
COMMITTEE ON SPACE RESEARCH, PARIS (FRANCE).
COSPAR's contribution to the early planning of the global observing system of the Global Weather Experiment N87-21473
COMMUNICATIONS SATELLITE CORP., CLARKSBURG, MD.
Design and development of a multi-kilowatt hour hydrogen/nickel oxide battery
[DE87-006774] N87-21250
CORNELL UNIV., ITHACA, N.Y.
Numerical grid generations for cascades with and without solution-adaption N87-20963
CRANFIELD INST. OF TECH., BEDFORD (ENGLAND).
Seeding gas flows for laser anemometry N87-21178

Application of Doppler and transit laser anemometry in small turbomachines N87-21180
Acquisition and analysis of dynamic rotating machinery data N87-21190

D

DANISH METEOROLOGICAL INST., COPENHAGEN.
Average configuration of the quiet auroral oval
[DMI-GEOPHYS-PAPERS-R-73] N87-21446
DAYTON UNIV., OHIO.
Assessment of remaining lubricant life
[AD-A177186] N87-21121
Numerical simulation of compressible Navier-Stokes flow in a double throat nozzle
[AD-A177023] N87-21271
Multicomponent flow compressor: A new concept for efficient energy conversion
[DE87-004011] N87-21278
DEFENCE RESEARCH ESTABLISHMENT, OTTAWA. (ONTARIO).
Canadian Coast Guard 406 MHz EPIRB (Emergency Position Indicating Radiobeacon) experimental results
[AD-A176430] N87-20978
Nonlinearity and single shot noise problems in CARS spectroscopy N87-21174
Diesel engine combustion program at the Defence Research Establishment Ottawa
[AD-A176436] N87-21336
DEFENCE RESEARCH INFORMATION CENTRE, ORPINGTON (ENGLAND).
Development of chemical sensors: Empirical art or systematic research?
[DRIC-T-7783] N87-21059
DEFENSE MAPPING AGENCY, WASHINGTON, D.C.
Use of GPS (Global Positioning System) for dynamic positioning of hydrographic survey platforms
[AD-A176218] N87-20983
DEPARTMENT OF ENERGY, WASHINGTON, D. C.
Introduction and status of the ceramic technology for advanced heat engines project
[DE87-004403] N87-21122
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, COLOGNE (WEST GERMANY).
Laser-2 focus velocimetry N87-21177
Evaluation of L2F-measurements in unsteady turbine flow N87-21182
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, GOETTINGEN (WEST GERMANY).
Particle imaging velocimetry in a low turbulent windtunnel and other flow facilities N87-21205
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN (WEST GERMANY).
Results of the Alpine Experiment (ALPEX) aircraft intercomparison on 19 April 1982 N87-21493
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, STUTTGART (WEST GERMANY).
Simultaneous temperature measurements with Raman and CARS in laminar flames N87-21171
DIRECTION DE LA METEOROLOGIE NATIONALE, PARIS (FRANCE).
Automatic mobile platforms N87-21477
The role of Alps mountains representation in the lee cyclogenesis simulation N87-21505
DOUGLAS AIRCRAFT CO., INC., LONG BEACH, CALIF.
An approach to practical aerodynamic calculations
[AD-A176995] N87-20970
DREXEL UNIV., PHILADELPHIA, PA.
Research on the statistics of grain lattice echoes and their use in grain size estimation and grain echo suppression
[AD-A176996] N87-21051
DU PONT DE NEMOURS (E. I.) AND CO., AIKEN, S.C.
Development of a telerobotic system for handling contaminated process equipment
[DE87-004186] N87-21346
Mobile robots in research and development programs at the Savannah River site
[DE87-003114] N87-21352
A flexible, computer-integrated robotic transfer system
[DE87-004183] N87-21619
Using vision systems when bar code won't work
[DE87-004514] N87-21740

E

ECOLE CENTRALE DE LYON (FRANCE).
Contribution to the study of the epoxy-glass interfaces in glass fiber reinforced composites
[ECL-86-10] N87-21055
State equation of condensed materials: Physical principles and applications
[ECL-86-15] N87-21069
Modeling the interactions shock wave/turbulent boundary layer. Comparison of model with experiment
[ECL-86-16] N87-21291
Mathematical and numerical study of a single side contact friction problem in elasticity and elastoplasticity
[ECL-85-09] N87-21358
Wear induced by small amplitude vibrations: Phenomena identification
[ECL-86-11] N87-21359
Study of ceramic-metal bonding: Application to copper-alumina bonding
[ECL-86-13] N87-21360
Study of an optimum design problem with frequency criteria applied to a structure-fluid coupled system
[ECL-86-06] N87-21396
Penalization study of a variational inequalities system used to model a cylindrical shell with symmetric loading
[ECL-86-08] N87-21397
Analysis of the feasibility of silicon on insulator submicron CMOS technology
[ECL-86-07] N87-21716
Contribution to understanding and modeling hot carrier injection phenomena in submicron MOS devices
[ECL-86-12] N87-21717
ECOLE NATIONALE SUPERIEURE DES TELECOMMUNICATIONS, PARIS (FRANCE).
Multispeaker number recognition
[ENST-86E008] N87-21225
Analysis and restitution of voice signals using evolving models
[ENST-86E009] N87-21226
EDGERTON, GERMESHAUSEN AND GRIER, INC., IDAHO FALLS, IDAHO.
Localized plasticity of graphite/magnesium metal matrix composites
[DE87-004542] N87-21053
Microstructural response of rapidly solidified 304 stainless steel powder to three consolidation techniques
[DE87-000439] N87-21100
EFP CO., LOGAN, UTAH.
LORAN-C tetroon transponder and tracking system
[PB87-116687] N87-20987
EG AND G ENERGY MEASUREMENTS, INC., LOS ALAMOS, N. MEX.
Amplitude-independent fiber-optic pressure sensor
[DE87-003873] N87-21662
EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND).
Analysis and quality of Alpine Experiment (ALPEX) data N87-21488
Vertical air motion and turbulence parameters from commercial aircraft N87-21494
Extremely rapid radio spikes in flares: A review N87-21798
ELORET CORP., PALO ALTO, CALIF.
Study of non-equilibrium transport phenomena
[NASA-CR-180441] N87-20965
Performance analysis of advanced spacecraft TPS
[NASA-CR-180496] N87-21011
Impact verification of space suit design for space station
[NASA-CR-180456] N87-21584
EMPIRE STATE ELECTRIC ENERGY RESEARCH CORP., NEW YORK.
LLE review
[DE87-005865] N87-21324
ENERGY RESEARCH CORP., DANBURY, CONN.
Corrosion resistant materials in MCFC environment
[DE87-004199] N87-21414
ENGINEERING, INC., HAMPTON, VA.
The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary
[NASA-CR-178276] N87-21020
ENVIRESPONSE, INC., LIVINGSTON, N.J.
Approach to evaluating leak detection methods in underground storage tanks
[PB87-118444] N87-21168
ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OHIO.
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[PB87-118444] N87-21168
ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, D.C.
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[PB87-131009] N87-21612
EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS, READING (ENGLAND).
Four-dimensional data assimilation N87-21481
Representation of pressure drag effects in numerical modeling of Alpine cyclogenesis N87-21503
Weather regimes and mountain effects in general circulation models: Implications for extended range weather forecasts N87-21513
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Proceedings of the Meteorological Motor Glider (MEMO) Workshop
[ESA-TT-845] N87-21453
Motor glider meteorology N87-21454
Typical and historical aspects of motor gliders as meteorological measuring aircraft N87-21455
Determination of vertical air velocity using measurements of the aircraft motion N87-21456
Influencing variables in the assessment of vertical wind velocity by means of flight-mechanics equations N87-21457
A comparison between Falcon data and motor glider data N87-21458
Case studies for flux measurements along a low-flying route to the south of Munich N87-21459
Environmental-physical measurements and determination of atmospheric turbulence with the ASK-16 motor glider N87-21460
Measurements of the vertical structure of the convective boundary layer N87-21461
Partioning of the vertical turbulent energy transport into positive and negative contributions N87-21462
Aircraft measurements during the Bonn Experiment (BONEX 1) N87-21463
Motor glider measurements during the urban atmosphere energy budget experiment (EESA 1) N87-21464
The determination of lee circulation during the Foehn wind N87-21465
Meteorological measurements with motor gliders in Poland N87-21466
Development and operation of a measuring data acquisition system for use in light airplanes N87-21467
Accuracy and error analysis N87-21468
Principles of wind measurement with the help of aircraft N87-21469
Ad astra HIPPARCOS. Astronomical mission of the European Space Agency
[ESA-BR-24] N87-21766
EUROPEAN SPACE AGENCY. EUROPEAN SPACE OPERATIONS CENTER, DARMSTADT (WEST GERMANY).
Meteosat contribution to Alpine Experiment (ALPEX): Highlights and limits N87-21495

F

FACTORY MUTUAL ENGINEERING, NORWOOD, MASS.
Prediction of fire properties of materials. Part 1: Aliphatic and aromatic hydrocarbons and related polymers
[PB87-140240] N87-21072
FEDERAL AVIATION AGENCY, ATLANTIC CITY, N.J.
Development of a large-scale antimisting kerosene blender
[AD-A176997] N87-21134
FERMI NATIONAL ACCELERATOR LAB., BATAVIA, ILL.
Inflation in the universe, Circa 1986
[DE87-005399] N87-21778
Inflation in spherically symmetric inhomogeneous models
[DE87-005405] N87-21779
FINNISH METEOROLOGICAL INST., HELSINKI.
Navigational Aid (NAVAID) vertical sounding system N87-21479
FLORIDA STATE UNIV., TALLAHASSEE.
Retrievals of lower stratospheric ozone profiles from Nimbus-4 and their use in a synoptic-climatological study N87-21423
FLORIDA UNIV., GAINESVILLE.
Delamination sensing and modeling in localized impacts on filament-reinforced laminated plates
[AD-A176474] N87-21048
FLUID DYNAMICS INTERNATIONAL, INC., EVANSTON, ILL.
Finite element calculations of viscoelastic fluid flow in a spinning and nutating cylinder
[AD-A176297] N87-21262

FORD AEROSPACE AND COMMUNICATIONS CORP., PALO ALTO, CALIF.
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 1: Executive summary
[NASA-CR-179597-VOL-1] N87-21212
The use of satellites in non-geostationary orbits for unloading geostationary communication satellite traffic peaks. Volume 2: Technical report
[NASA-CR-179597-VOL-2] N87-21213
FRACTURE CONTROL CORP., GOLETA, CALIF.
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[DE87-006010] N87-21107
FREIE UNIV., BERLIN (WEST GERMANY).
Fine mesh analysis of Genoa cyclogenesis by use of isentropic coordinates N87-21509

G

GENERAL DYNAMICS CORP., HUNTSVILLE, ALA.
Orbital transfer vehicle concept definition and system analysis study. Volume 1A: Executive summary. Phase 2
[NASA-CR-179055] N87-21018
GENERAL DYNAMICS CORP., SAN DIEGO, CALIF.
Long term cryogenic storage facility systems study N87-21143
GENERAL ELECTRIC CO., NEW YORK.
LLE review
[DE87-005865] N87-21324
GEO-CENTERS, INC., NEWTON, MASS.
Performance test of 110 mm bore ball bearing made from corrosion resistant powdered steel
[AD-A177060] N87-21342
GEORGE WASHINGTON UNIV., WASHINGTON, D.C.
Flow induction by rotary jets
[AD-A177013] N87-21270
GEORGIA INST. OF TECH., ATLANTA.
Studies in non-linear unsteady aerodynamics
[AD-A177006] N87-20971
Investigation of the characteristics of liquid fuel burning, Rijke type, pulsating combustors
[DE87-001931] N87-21063
Retrieval of moving waves from polar orbiting satellite data N87-21404
GLASGOW UNIV. (SCOTLAND).
Plasma turbulence and impulsive UV line emission in solar flares N87-21818
The effect of beam-driven return current instability on solar hard X-ray bursts N87-21820
The quasi-linear relaxation of thick-target electron beams in solar flares N87-21825

H

HAHN-MEITNER-INSTITUT FUER KERNFORSCHUNG, BERLIN (WEST GERMANY).
NILFIT: An interactive system for nonlinear fit of data
[HMI-B431] N87-21607
A method for the construction of continuously differentiable surfaces for the interpolation of scattered data
[HMI-B371] N87-21628
HAMILTON STANDARD, WINDSOR LOCKS, CONN.
Maintenance evaluation for space station liquid systems N87-21155
HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH.
Effects of irradiation on the fracture toughness of Alloy 718 plate and weld
[DE87-004345] N87-21102
HARRIS CORP., MELBOURNE, FLA.
OPUS: Optimal Projection for Uncertain Systems
[AD-A176820] N87-21025
HARRY DIAMOND LABS., ADELPHI, MD.
Comparison between calculated and measured forward and reverse current-voltage characteristics
[AD-A176807] N87-21241
HARVARD UNIV., CAMBRIDGE, MASS.
Picosecond laser pulse interactions with metallic and semiconductor surfaces
[AD-A176645] N87-21087
Analysis of picosecond pulsed laser melted graphite
[DE87-003755] N87-21124
HAWAII UNIV., HONOLULU.
The binary weight distribution of the extended (2 sup m, 2 sup m-4) code of Reed-Solomon code over GF(2 sup m) with generator polynomial (x-alpha sup 2) (x-alpha sup 3)
[NASA-CR-180510] N87-21625
Research in planetary studies and operation of the Mauna Kea Observatory
[NASA-CR-180513] N87-21763
Spectral reflectance (0.4 - 5.0 microns) of sulfur related compounds and mixtures
[NASA-CR-180525] N87-21781
HELSINKI UNIV. (FINLAND).
Global diagnostic studies based on data collected during the Global Experiment N87-21483
HOUSELINE, INC., SWARTHMORE, PA.
A new methodology of determining directional albedo models from Nimbus 7 ERB scanning radiometer measurements
[NASA-CR-177908] N87-21764
Comparison of long-wave and shortwave irradiances at satellite altitude with integrated scanner measurements using the Nimbus 7 ERB data set
[NASA-CR-177909] N87-21834
HOUSTON UNIV., TEX.
Structure theories and applications of multivariable control systems described by block canonical forms
[AD-A176482] N87-21615
HOWARD UNIV., WASHINGTON, D. C.
Neurohumoral and mechanical factors in the modulation of left ventricular mass
[NASA-CR-180524] N87-21554
HUGHES RESEARCH LABS., MALIBU, CALIF.
Cluster beam studies
[AD-A176803] N87-21163
HYDRO-ELECTRIC POWER COMMISSION, TORONTO (ONTARIO).
LLE review
[DE87-005865] N87-21324
HYDROMETEOROLOGICAL CENTRE OF THE USSR (MOSCOW).
Ship-borne systems for observing wind in the tropical zone N87-21480

I

IBM WATSON RESEARCH CENTER, YORKTOWN HEIGHTS, N.Y.
Synchrotron radiation studies of MBE-grown semiconductor and metal surfaces and interfaces
[AD-A176445] N87-21691
IDAHO NATIONAL ENGINEERING LAB., IDAHO FALLS.
Ultrasonic detection of weld bead geometry
[DE87-004441] N87-21366
IIT RESEARCH INST., BARTLESVILLE, OKLA.
Techniques to determine particulates in liquid fuels
[DE87-002028] N87-21135
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136
ILLINOIS UNIV., URBANA.
Scattering from general periodic screens
[AD-A176405] N87-21216
IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).
Velocity and temperature measurements in a can-type gas-turbine combustor N87-21184
INDIANA UNIV., INDIANAPOLIS.
Sleep deprivation and exercise tolerance
[AD-A176171] N87-21555
INNSBRUCK UNIV. (AUSTRIA).
The quality of the Alpine Experiment (ALPEX) 2b data set with regard to the application of vorticity dynamics N87-21490
On the synoptics and dynamics of orographically induced cyclones in the Mediterranean N87-21506
INSTITUT DE MECANIQUE DES FLUIDES DE LILLE (FRANCE).
Study of various holographic assemblies to observe particles smaller than diffraction length, in flows with or without density gradients
[IMFL-86/21] N87-21309
INSTITUT NATIONAL DES SCIENCES APPLIQUEES, LYON (FRANCE).
Preparation and characterization of potassium hydroaluminates KAlH4, K3AlH6, K2NaAlH6, K3AlH4F2
[INSA-IDTC1-8602] N87-21067
Lead titanates: Electromechanical anisotropic materials applicable to electroacoustic instrumentation
[INSA-IDI1-8603] N87-21068
Modeling the convection-radiation coupling in porous materials and identification of their radiation characteristics: Application to glass wools
[INSA-86-ISAL-0007] N87-21290
INSTITUTE FOR ATMOSPHERIC OPTICS AND REMOTE SENSING, HAMPTON, VA.
Validation of SAM 2 and SAGE satellite
[NASA-CR-178256] N87-21429
INSTITUTE FOR METEOROLOGY AND WATER ECONOMY, CRACOW (POLAND).
Accuracy of temperature fields and local data sets for the Tatra mountains (Poland) N87-21492
INSTITUTO DE PESQUISAS ESPACIAIS, SAO JOSE DOS CAMPOS (BRAZIL).
Rapid spectral and flux time variations in a solar burst observed at various dm-mm wavelengths and at hard X-rays N87-21803
INSTITUTO SUPERIOR TECNICO, LISBON (PORTUGAL).
The flow around a squared obstacle N87-21185
Processing techniques for correlation of LDA and thermocouple signals N87-21194
INTER-AMERICAN GEODETIC SURVEY, APO MIAMI, FLA.
The Universal Transverse Mercator grid formulas for cartographic applications programmers
[AD-A176824] N87-21407
INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS, ROME (ITALY).
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[WMO-TD-107-VOL-1] N87-21470
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Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521
INTERNATIONAL METEOROLOGICAL INST., STOCKHOLM (SWEDEN).
The observational objectives and the implementation of the Global Weather Experiment N87-21474
IOWA STATE UNIV. OF SCIENCE AND TECHNOLOGY, AMES.
Boundary-layer computational model for predicting the flow and heat transfer in sudden expansions
[NASA-CR-180272] N87-21303
Very high energy gamma ray astrophysics
[DE87-006293] N87-21842
IOWA UNIV., IOWA CITY.
Computer-aided analysis of two-dimensional laminar and turbulent incompressible flows N87-21256
Plasma physics abstracts, 1 January - 31 December, 1986
[NASA-CR-180220] N87-21684
ISTITUTO DI FISICA DELL ATMOSFERA, ROME (ITALY).
Review of the weather phenomena observed during the Alpine Experiment (ALPEX) special observing period N87-21487
Remotely sensed sea surface temperature for the Alpine Experiment (ALPEX) N87-21497
A theory of deep cyclogenesis in the lee of the Alps: Modification of baroclinic instability by topography N87-21499
The mechanisms of orographic cyclogenesis N87-21500
A normal mode nongeostrophic model of lee cyclogenesis N87-21501
Stratified flow and wave motion near mountain tops N87-21514
ISTITUTO ELETTROTECNICO NAZIONALE (GALILEO FERRARIS), TURIN (ITALY).
Activities report in electrical technology
[ETN-87-99354] N87-21253
IT CORP., PITTSBURGH, PA.
Approach to evaluating leak detection methods in underground storage tanks
[PB87-116444] N87-21168

J

JAPAN METEOROLOGICAL AGENCY, TOKYO.
Improvements in geostationary satellite wind observations as a result of the Global Weather Experiment and applications of these in the context of the World Weather Watch (WWW) system N87-21476
JET PROPULSION LAB., CALIFORNIA INST. OF TECH., PASADENA.
High efficiency crystalline silicon solar cells
[NASA-CR-180530] N87-21411
The comet Giacobini-Zinner magnetotail: Axial stresses and inferred near-nucleus properties
[DE87-003712] N87-21775
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784
Hard X-ray delays N87-21796
JOHNS HOPKINS UNIV., BALTIMORE, MD.
A fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys
[AD-A176970] N87-21089

JOHNS HOPKINS UNIV., SILVER SPRING, MD.
Interpretation of rapid rises in hard X-rays and microwaves with the thermal conduction front model
N87-21786

JOHNSON (DAVID S.), ANNAPOLIS, MD.
Meteorological parameters derived from space-based observing systems, during the Global Weather Experiment and after
N87-21475

JOINT INST. FOR LAB. ASTROPHYSICS, BOULDER, COLO.
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[DE87-001982] N87-21765
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[JPRS-USB-87-001] N87-21558
Incention of Soviet system of medical screening of cosmonauts (hospital stage)
N87-21559
Effect of spaceflight factors on hemopoiesis
N87-21560
Evaluation of functional state of pilots on the basis of interhemispheric asymmetry
N87-21561
Individual distinctions of fluid-electrolyte metabolism during hypokinesia with head-down tilt for 120 days and efficacy of preventive agents
N87-21562
Bioelectrical activity of the heart and blood electrolytes in essentially healthy subjects submitted to antiorthostatic hypokinesia for 120 days
N87-21563
Effect of immersion hypokinesia on some parameters of human muscle potentials
N87-21564
Change in bile acid and lipid content of human bile during exposure to antiorthostatic hypokinesia and its correction
N87-21565
Quantitative study of osteoblasts and osteoclasts of rat bones with simulation of weightlessness
N87-21566
Hydrolysis, transport and utilization of carbohydrates in rats with restricted motor activity
N87-21567
Possibility of pharmacological correction of regional osteoporosis in nonbearing extremity
N87-21568
Morphological and biochemical analysis of some rat organs and tissues following exposure to 1.1 and 2.0 G gravity
N87-21569
Effect of altered circulation on human nystagmic reactions
N87-21570
Thresholds of long-latency-period potentials and sensation of motion evoked in man by linear accelerations
N87-21571
Mathematical model of the otolith
N87-21572
Reactivity of adrenosympathetic system and tolerance to exercise load during repeated exposure to stationary magnetic field
N87-21573
Direct and indirect effects of stationary magnetic field on biological systems
N87-21574
Derivation of working equations of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte with consideration of extracted oxygen
N87-21575
Calculation of equilibrated concentrations of constituents of CO2-CO-H2O-H2-N2 gas mixture for cathode space of electrolyzer with solid electrolyte and corresponding values of theoretical voltage of dissociation
N87-21576
Some pathological signs in pelvis minor organs after exposure to long-term high-level +Gz accelerations
N87-21577
Group dynamics and performance efficiency under extreme conditions
N87-21578
Mechanism of action of local negative pressure applied to human body on dynamics of central circulation
N87-21579
Rat brain polyamine levels during long-term hypokinesia
N87-21580
Reaction of sympathectomied rat opioid system to immobilization stress
N87-21581
Radiosensitivity of escherichia coli following irradiation in a stationary magnetic field
N87-21582

K

KERNFORSCHUNGSANLAGE, JUELICH (WEST GERMANY).
Use of laser-Doppler-anemometry for the measurement of velocity distributions at the intake of a longitudinal flow heat exchanger
[JUEL-SPEZ-362] N87-21293

KERNFORSCHUNGSZENTRUM, KARLSRUHE (WEST GERMANY).
A modeling and simulation tool for fault-tolerant distributed systems applied to distributed database management systems
[KFK-4138] N87-21614
Cubic Interpolated pseudo-Particle (CIP): A new numerical solver for general nonlinear hyperbolic equations in multidimension
[KFK-4154] N87-21631
GANTRAS: A system of codes for the solution of the multigroup transport equation with a rigorous treatment of anisotropic neutron scattering. Plane and spherical geometry
[KFK-4163] N87-21665
Behavior of UO2 and fissium in sodium vapor atmosphere at temperatures up to 2800 C
[KFK-4135] N87-21677

KIRUNA GEOPHYSICAL INST. (SWEDEN).
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[KGI-PREPRINT-096] N87-21444
A new method of organizing spectral line intensity ratio fluctuations of auroral and nightglow emissions
[KGI-193] N87-21445

KMS FUSION, INC., ANN ARBOR, MICH.
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[DE87-002823] N87-21325

L

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[INSA-IDI-186-05] N87-21687

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Maximum principle for viscous fluids flowing through regions of pure fluid and mixtures
[DE86-780543] N87-21277

LAND TURBINE SENSORS, INC., TULLYTOWN, PA.
Some considerations relating to aero engine pyrometry
N87-21187

LASER APPLICATIONS RESEARCH CENTER, THE WOODLANDS, TEX.
Short wavelength laser/materials interactions
[AD-A176950] N87-21316

LAWRENCE LIVERMORE NATIONAL LAB., CALIF.
Efficient methods for evaluating the effects of stressful electromagnetic environments on complex systems
[DE86-008030] N87-21224
Aluminum-air battery crystallizer
[DE87-005839] N87-21252
Turbulent energy generated by accelerations and shocks
[DE87-002377] N87-21274
On the artificial viscosity in 1D spherical geometry
[DE87-004449] N87-21279
Shock wave interaction with turbulence: Pseudospectral simulations
[DE87-004357] N87-21281
A laser Doppler metho for noninvasive measurement of flow velocity
[DE87-005197] N87-21283
Development of a two-equation turbulent mix model
[DE87-005837] N87-21284
Precision cutting and drilling with the Nd-YAG laser
[DE87-001359] N87-21317
Laser microfabrication technology and its application to high speed interconnect of gate arrays
[DE87-004363] N87-21320
An Overview of the Lawrence Livermore National Laboratory Free Electron Laser Program
[DE87-005815] N87-21330
Laser welding metallography
[DE87-004113] N87-21348
A parameterized numerical fit to total column ozone changes calculated by the LLNL 1-D model of the troposphere and stratosphere
[DE87-003600] N87-21438
Induction linear accelerator technology for SDIO applications
[DE87-003251] N87-21642
Advanced sensors, telecommunications and data processing: Technological spin-offs from the Strategic Defense Initiative
[DE87-003884] N87-21757
Relativistic (3+1) dimensional hydrodynamic simulations of compact interacting binary systems
[DE87-000602] N87-21771

LOCKHEED MISSILES AND SPACE CO., HUNTSVILLE, ALA.
Filament wound data base development, revision 1, appendix A
[NASA-CR-179069] N87-21015
Filament wound data base development, revision 1
[NASA-CR-179068-REV-1] N87-21016
Filament wound data base development, revision 1, appendix B
[NASA-CR-179070] N87-21017

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Polydiacetylene single crystal fibres and their use in fibre-reinforced composites
[AD-A176827] N87-21049

LOS ALAMOS NATIONAL LAB., N. MEX.
Stage 4 work hardening in cubic metals
[DE87-003756] N87-21094
Analysis of picosecond pulsed laser melted graphite
[DE87-003755] N87-21124
A study of the propagation of ULF electromagnetic fields in collisional, inhomogeneous, magnetized plasmas
[DE87-004768] N87-21223
Graphite as a picosecond laser activated opening switch
[DE87-003758] N87-21251
Convectively driven superfluid turbulence in dilute solutions of He3 in superfluid He4
[DE87-002918] N87-21275
A self-similar approach to the explosion of droplets by a high energy laser beam
[DE87-005124] N87-21322
An overview of the long pulse experiment
[DE87-003738] N87-21326
Multifacet, metal mirror design for extreme-ultraviolet and soft X-ray free-electron laser resonators
[DE87-005100] N87-21328
Layered target burnthrough experiments using 50 nsec KrF laser pulses
[DE87-005111] N87-21329
Three dimensional numerical simulations of the UPS-292-SC engine
[DE87-001968] N87-21344
General finite strain tensors
[DE87-003807] N87-21391
Observations and theory of the AMPTE (Active Magnetospheric Particle Tracer Explorers) magnetotail barium releases
[DE87-006325] N87-21440
Spectral signatures from short-pulse microwave air breakdown
[DE87-006116] N87-21686
GaAs photoconductors to characterize picosecond response in GaAs integrated devices and circuits
[DE87-003744] N87-21704
Characterization of on-chip polycrystalline silicon photoconductors
[DE87-003745] N87-21705
The gravitational properties of antimatter
[DE87-003367] N87-21725
Using nonradial pulsations to determ. e the envelope composition of very evolved stars
[DE87-001982] N87-21765
Theoretical and observational review of results on nova explosions occurring on ONeMg white dwarfs
[DE87-001962] N87-21772
Pulsations of white dwarf stars with thick hydrogen or helium surface layers
[DE87-001954] N87-21774
The comet Giacobini-Zinner magnetotail: Axial stresses and inferred near-nucleus properties
[DE87-003712] N87-21775
Pulsations of B stars: A review of observations and theories
[DE87-003717] N87-21776
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
Model ion abundances for comet Halley
[DE87-003710] N87-21783
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784
A third class of high energy burster
[DE87-006051] N87-21841

LOUVAIN UNIV. (BELGIUM).
Nature of coupling and dimensional crossover in superconducting multilayers
[DE87-004676] N87-21706
Superconducting properties of compositionally modulated Pb/Ge thin films
[DE87-004679] N87-21708

M

MARCONI SPACE SYSTEMS LTD., PORTSMOUTH (ENGLAND).
Towards an object oriented satellite test environment
[ETN-87-99476] N87-21031
Testing of the advanced microwave instrument for the European Remote Sensing Satellite ERS-1
[ETN-87-99477] N87-21409

MARTIN MARIETTA AEROSPACE, DENVER, COLO.
Localized plasticity of graphite/magnesium metal matrix composites
[DE87-004542] N87-21053

MARTIN MARIETTA CORP., DENVER, COLO.
Shuttle middeck fluid transfer experiment: Lessons learned N87-21158

MARTIN MARIETTA ENERGY SYSTEMS, INC., OAK RIDGE, TENN.
Inertia friction welding of 1100 aluminum to type 316 stainless steel
[DE87-005044] N87-21347

MARYLAND UNIV., COLLEGE PARK.
Graphite as a picosecond laser activated opening switch
[DE87-003758] N87-21251
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784
Solar microwave millisecond spike at 2.84 GHz N87-21809

MASSACHUSETTS GENERAL HOSPITAL, BOSTON.
Development of nuclear magnetic resonance imaging techniques for characterizing green-state ceramic materials
[DE87-004987] N87-21123

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Space-charge-induced breakdown in dielectrics
[AD-A176969] N87-21029
Turbulent premixed flame study
[DE87-006255] N87-21066
Oxidation behavior of chromium and a chromium-yttrium binary alloy
[DE87-003772] N87-21095
Analysis of picosecond pulsed laser melted graphite
[DE87-003755] N87-21124
The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement N87-21147
Compaction with automatic jog introduction
[AD-A176525] N87-21240
Fluid dynamics of high performance turbomachines
[AD-A177003] N87-21341
Three dimensional dynamical and chemical modelling of the upper atmosphere
[NASA-CR-180514] N87-21428
Directory of MIT (Massachusetts Institute of Technology) Sea Grant College Program publications, 1976-1986
[PB87-137105] N87-21550
A coordinate conversion algorithm for multisensor data processing
[AD-A176366] N87-21603
The X window system
[AD-A176476] N87-21604

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[AD-A177080] N87-21437

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[MQAD-TP-911] N87-21114

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[AD-A176211] N87-21079

MATERIALS RESEARCH LABS., MELBOURNE (AUSTRALIA).
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[MRL-TN-509] N87-21008
The magnetic flux contributed by the plasma armature in an electromagnetic launcher
[MRL-R-1033] N87-21009

MAX-PLANCK-INST. FUER AERONOMIE, KATLENBURG-LINDAU (WEST GERMANY).
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784

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Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782
Model ion abundances for comet Halley
[DE87-003710] N87-21783

MCDONNELL-DOUGLAS ASTRONAUTICS CO., HUNTINGTON BEACH, CALIF.
Solar wind plasma in the magnetosphere method of entry and consequences
[AD-A177255] N87-21835

MCDONNELL-DOUGLAS CORP., ST. LOUIS, MO.
Shuttle get-away special experiments N87-21157

METRAFLU, ECULLY (FRANCE).
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 2: Manifestations of the mechanisms related to large oriented structures in homogeneous turbulence. Part A: Experimental study. Part B: Theoretical study
[ETN-87-99395] N87-21294
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 3: Spectral manifestations of inhomogeneity due to field effects and to the presence of walls
[ETN-87-99396] N87-21295
Theoretical and experimental synthesis of turbulence estimation spectral methods for aerodynamic computations. Part 4: Study of entrainment mechanisms using simulations and experimental results
[ETN-87-99397] N87-21296

MICHIGAN STATE UNIV., EAST LANSING.
Dynamic recrystallization during high temperature low cycle fatigue of nickel
[DE87-006152] N87-21103

MICHIGAN TECHNOLOGICAL UNIV., HOUGHTON.
Ductile fracture and random versus regular hole/void arrays
[AD-A176627] N87-21085
Stress corrosion cracking and metal-induced embrittlement: Comparative studies of local chemistries
[DE87-004300] N87-21097

MICHIGAN UNIV., ANN ARBOR.
Investigations on the MBE growth and properties of Al/(y)/Ga/(y)/In/(1-x-y/As/InP) and InAlAs superlattices
[DE87-005190] N87-21709

MIDWEST RESEARCH INST., GOLDEN, COLO.
Mixing in a double-diffusive, partially stratified fluid
[DE87-001131] N87-21285

MINNESOTA UNIV., MINNEAPOLIS.
Network polymers formed under nonideal conditions
[AD-A176408] N87-21115

MOBIL TYCO SOLAR ENERGY CORP., WALTHAM, MASS.
Stress and efficiency studies in EFG
[NASA-CR-180527] N87-21412

MORTON THIOKOL, BRIGHAM CITY, UTAH.
Block 2 SRM conceptual design studies. Volume 1, Book 1: Conceptual design package
[NASA-CR-179048] N87-21034
Block 2 SRM conceptual design studies. Volume 1, Book 1: Appendix A: CEI specification CPW1-1900, Appendix B: Composite motor case
[NASA-CR-179049] N87-21035
Block 2 SRM conceptual design studies. Volume 1, Book 2: Preliminary development and verification plan
[NASA-CR-179054] N87-21036

MOSCOW STATE UNIV. (USSR).
Diagnostic research into the tropical atmosphere and the role of tropical processes in the general circulation N87-21484

MOTOREN- UND TURBINEN-UNION MUENCHEN G.M.B.H. (WEST GERMANY).
Vibration analysis by speckle interferometry N87-21197
Tip clearance measurement in modern compressor components N87-21199

MOUND LAB., MIAMISBURG, OHIO.
Development of the diffusion bonding process
[DE87-006598] N87-21164
Measurement of fatigue crack growth kinetics of Copper-Kapton laminates by dynamic mechanical thermal analysis
[DE87-003024] N87-21390

MSNW, INC., SAN MARCOS, CALIF.
Plasma joining of metal matrix composites
[AD-A176690] N87-21042

N

NAGOYA UNIV. (JAPAN).
A Japanese plan: Large radio heliograph in the solar max no. 22 N87-21831

NANJING UNIV. (CHINA).
Statistical analysis of fast hard X-ray bursts by SMM observations and microwave bursts by ground-based observations N87-21793
Microwave and hard X-ray emissions during the impulsive phase of solar flares: Nonthermal electron spectrum and time delay N87-21794
Microwave millisecond spike emission and its associated phenomena during the impulsive phase of large flares N87-21805
Electron-cyclotron maser and solar microwave millisecond spike emission N87-21819

NATIONAAL INST. VOOR KERNFYSICA EN HOGE ENERGIEFYSICA, AMSTERDAM (NETHERLANDS).
A drift chamber with variable drift velocity
[NIKHEF-H/86-12] N87-21310
Joint production of phi mesons and pi(+,-), pi(0), rho, rho bar, K(0)S and K(+,-) in hadronic interactions
[NIKHEF-H/86-2] N87-21663
Supermultiplets in Hilbert space for the supersymmetric bag model
[NIKHEF-H/86-5] N87-21664
SC correction coils and magnets for the HERA proton ring
[NIKHEF-H/86-10] N87-21676
Multiplet calculus and compensating fields in D = 2 conformal supergravity
[NIKHEF-H/86-11] N87-21726
The d=2 conformal gauge theory
[NIKHEF-H/86-13] N87-21727
Residual supersymmetry of compactified d=10 supergravity
[NIKHEF-H/86-15] N87-21728
Evaluation of the OSI LD1200 optical diskdrive
[NIKHEF-H/86-17] N87-21744

NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, WASHINGTON, D. C.
Net shape technology in aerospace structures. Volume 1
[AD-A176508] N87-20957
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[AD-A176509] N87-20958
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[AD-A176510] N87-20959
Net shape technology in aerospace structures. Volume 4. Appendix. Future Composite Manufacturing Technology. Presentations of a workshop held on September 9-12, 1985 in Gaithersburg, Maryland
[AD-A176511] N87-20960
Aircraft and engine development testing
[AD-A176711] N87-20961
Accuracy of time transfer in satellite systems
[AD-A176579] N87-20984
Energetic materials for military purposes: An assessment
[PB87-137220] N87-21138
Papers presented at a Workshop on Electric Energy Systems Research
[PB87-137238] N87-21254
Atmospheric climate data: Problems and promises
[NASA-CR-180442] N87-21450
An agenda for improved evaluation of supercomputer performance
[DE87-005698] N87-21593
Agenda for improved evaluation of supercomputer performance
[PB87-137196] N87-21596
Physics at the laser-atomic frontier
[PB87-126611] N87-21646

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D.C.
Aeronautical engineering: A continuing bibliography with indexes (supplement 213)
[NASA-SP-7037(213)] N87-20955
Aeronautical engineering: A cumulative index to a continuing bibliography
[NASA-SP-7037(209)] N87-20956
Automatic processing system for shadowgraph and interference patterns
[NASA-TM-88525] N87-21307
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 297)
[NASA-SP-7011(297)] N87-21552
University program management information system, fiscal year 1986.
[PB87-127379] N87-21736

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.
Experimental determination of the stable-trim attitudes of two proposed, general-purpose, heat-source modules
[NASA-TM-88345] N87-20967
Rotary-wing aircraft terrain-following/terrain-avoidance system development
[NASA-TM-88323] N87-20982
Summary of studies to reduce wing-mounted propfan installation drag on an M = 0.8 transport
[NASA-TP-2678] N87-20990
Challenges in modeling the X-29 flight test performance
[NASA-TM-88282] N87-20991
A new design concept for indraft wind-tunnel inlets with application to the national full-scale aerodynamic complex
[NASA-TM-88226] N87-21006
Infrared absorption and emission characteristics of interstellar PAHs
[NASA-TM-89287] N87-21075
Process for preparing phthalocyanine polymer from imide containing biphthalonitrile
[NASA-CASE-ARC-11511-2] N87-21112
Helium technology issues N87-21145
Liquid seeding atomizer
[NASA-CASE-ARC-11631-1] N87-21255
The hydrogen coverage of interstellar PAHs
[NASA-TM-89340] N87-21780

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. DRYDEN (HUGH L.) FLIGHT RESEARCH CENTER, EDWARDS, CALIF.
In-flight surface oil-flow photographs with comparisons to pressure distribution and boundary-layer data
[NASA-TP-2395] N87-20966

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
Superfluid helium on orbit transfer (SHOOT) N87-21151
Low phase noise oscillator using two parallel connected amplifiers
[NASA-CASE-GSC-13018-1] N87-21232
Tidal estimation in the Atlantic and Indian Oceans, 3 deg x 3 deg solution
[NASA-TM-87812] N87-21534
Optical scanner
[NASA-CASE-GSC-12897-1] N87-21679
Rapid Fluctuations in Solar Flares
[NASA-CP-2449] N87-21785
Persistent time intervals between features in solar flare hard X-ray emission N87-21790
Fast fluctuations of soft X-rays from active regions N87-21797
Relation between solar narrow-band decimeter wave bursts and associated X-ray bursts N87-21799
The role of narrowband dm-spikes in solar flares N87-21801
The possible importance of synchrotron/inverse Compton losses to explain fast mm-wave and hard X-ray emission of a solar event N87-21802
Quasi-periodic pulsations in solar hard X-ray and microwave flares N87-21804
Comparison of solar hard X-ray and UV line and continuum bursts with high time resolution N87-21813
OV and hard X-rays, observations and model calculations N87-21814
Soft X-ray oscillations during the flare of 7 August 1972 N87-21816
Shock acceleration of electrons and ions in solar flares N87-21823
The generation of rapid solar flare hard X-ray and microwave fluctuations in current sheets N87-21824
The HESP (High Energy Solar Physics) project N87-21832
The proposed NRAO millimeter array and its use for solar studies N87-21833

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN F. KENNEDY SPACE CENTER, COCOA BEACH, FLA.
Personnel emergency carrier vehicle
[NASA-CASE-KSC-11282-1] N87-21755

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEX.
Microgravity fluid management in two-phase thermal systems N87-21152

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.
Algorithm implementation on the Navier-Stokes computer
[NASA-TM-89119] N87-20968
Airplane automatic control force trimming device for asymmetric engine failures
[NASA-CASE-LAR-13280-1] N87-20999
Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna
[NASA-TM-89137] N87-21021
Measurement apparatus and procedure for the determination of surface emissivities
[NASA-CASE-LAR-13455-1] N87-21206
Comparator with noise suppression
[NASA-CASE-LAR-13151-1] N87-21235
Toward the large-eddy simulations of compressible turbulent flows
[NASA-CR-178273] N87-21259
Preliminary report on candidates for AGARD standard aeroelastic configurations for dynamic response
[NASA-TM-89142] N87-21376
Convergence of strain energy release rate components for edge-delaminated composite laminates
[NASA-TM-89135] N87-21377
Exploiting loop level parallelism in nonprocedural dataflow programs
[NASA-CR-178277] N87-21613
Acoustic guide for noise-transmission testing of aircraft
[NASA-CASE-LAR-13111-1-CU] N87-21652
Acoustic radiation stress measurement
[NASA-CASE-LAR-13440-1] N87-21653

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OHIO.
The NASA Electric Propulsion Program
[NASA-TM-89856] N87-21037
Styrene-terminated polysulfone oligomers as matrix material for graphite reinforced composites: An initial study
[NASA-TM-89846] N87-21043
Superalloy resources: Supply and availability
[NASA-TM-89866] N87-21077
Analysis of plasma-nitrided steels
[NASA-TM-89815] N87-21078
Microgravity Fluid Management Symposium
[NASA-CP-2465] N87-21141
Cryogenic Fluid Management Flight Experiment (CFMFE) N87-21150
Space experiment development process N87-21156
Ion beam sputter etching
[NASA-CASE-LEW-13899-1] N87-21160
Laser fringe anemometry for aero engine components N87-21176
Combined fringe and Fabry-Perot laser anemometer for 3 component velocity measurements in turbine stator cascade facility N87-21183
Beam-modulation methods in quantitative and flow-visualization holographic interferometry N87-21204
Precision tunable resonant microwave cavity
[NASA-CASE-LEW-13935-1] N87-21234
Traveling-wave-tube efficiency improvement by a low-cost technique for deposition of carbon on multistage depressed collector
[NASA-TP-2719] N87-21239
A NASTRAN primer for the analysis of rotating flexible blades
[NASA-TM-89861] N87-21375
A 1987 overview of free-piston Stirling technology for space power application
[NASA-TM-89832] N87-21756

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.
The corrosion mechanisms for primer coated 2219-T87 aluminum
[NASA-TP-2715] N87-21076
Quasi-containerless glass formation method and apparatus
[NASA-CASE-MFS-28090-1] N87-21111
Advanced long term cryogenic storage systems N87-21142
Four quadrant control circuit for a brushless three-phase dc motor
[NASA-CASE-MFS-28080-1] N87-21233
Dual motion valve with single motion input
[NASA-CASE-MFS-28058-1] N87-21332
Self indexing latch system
[NASA-CASE-MFS-25956-1] N87-21333
Bidirectional control system for energy flow in solar powered flywheel
[NASA-CASE-MFS-25978-1] N87-21410
Fast temporal correlation between hard X-ray and ultraviolet continuum brightenings N87-21812

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. PASADENA OFFICE, CALIF.
Ten degree Kelvin hydride refrigerator
[NASA-CASE-NPO-16393-1-CU] N87-21159
Synchronization tracking in pulse position modulation receiver
[NASA-CASE-NPO-16256-1] N87-21207
Low noise lead screw positioner
[NASA-CASE-NPO-15617-1] N87-21304
Method for forming hermetic seals
[NASA-CASE-NPO-16423-1-CU] N87-21334
Reed-Solomon decoder
[NASA-CASE-NPO-15982-1] N87-21591
Generation of intense negative ion beams
[NASA-CASE-NPO-16061-1-CU] N87-21660
Variable energy, high flux, ground-state atomic oxygen source
[NASA-CASE-NPO-16640-1-CU] N87-21661

NATIONAL AEROSPACE LAB., AMSTERDAM (NETHERLANDS).
Foundations and applications of multispectral scanning in agriculture
[NLR-MP-85015-U] N87-21408
The application of Computer Aided Design (CAD) techniques in a route-planning system
[NLR-MP-85039-U] N87-21605
Introduction to the development of automation plans for Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) in mechanical engineering
[NLR-MP-85042-U] N87-21606
Artificial intelligence techniques for working with knowledge
[NLR-MP-85037-U] N87-21621
Providing knowledge by means of artificial intelligence techniques: Experiences and developments at the National Aerospace Laboratory (NLR)
[NLR-MP-85081-U] N87-21622
Irregular modes in a duct with an impedance wall
[NLR-MP-85086-U] N87-21656
Some aspects of fan noise generation in axial compressors
[NLR-MP-85089-U] N87-21657
Management of automation projects that are relevant for the Royal Dutch Meteorological Institute (KNMI)
[NLR-MP-85075-U] N87-21734
Flexible and dynamic data model applied in an engineering data management system
[NLR-MP-85011-U] N87-21741
Applied informatics in practice
[NLR-MP-85028-U] N87-21742
Automation strategy for a Royal Netherlands Air Force (RNLAF) air base command and control information system
[NLR-MP-85070] N87-21743

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MARC (Machine Readable Catalog) format and life cycle tracking at the National Archives: A study
[PB87-126256] N87-21737

NATIONAL BUREAU OF STANDARDS, BOULDER, COLO.
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[NASA-CR-180265] N87-21139
STARPAC: The standard times series and regression package
[PB87-152385] N87-21641
Evaluation of off-axis measurements performed in an anechoic chamber
[PB87-134367] N87-21658
Electromechanical properties of superconductors for high-energy physics applications
[DE87-006048] N87-21715
Handbook for operation and maintenance of an NBS (National Bureau of Standards) multisensor automated EM (electromagnetic) field measurement system
[PB87-140729] N87-21749

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Gravimetric technique for the preparation of accurate trace organic gas standards
[PB87-145736] N87-21074
Comparison of the toxicity of the combustion products from a flexible polyurethane foam and a polyester fabric evaluated separately and together by the NBS (National Bureau of Standards) toxicity test method and a cone radiant heater toxicity test apparatus
[PB87-140265] N87-21169
Time-dependent simulation of small-scale turbulent mixing and reaction
[PB87-140257] N87-21302
Nondestructive evaluation activities in the Semiconductor Materials and Processes Division
[PB87-140174] N87-21368
Handbook for the Quality Assurance of Meteorological measurements
[PB87-140422] N87-21452
Guidance on software package selection
[PB87-140810] N87-21610

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[PB87-140315] N87-21651
Crystal data: Version 1.0 database specifications
[PB87-140414] N87-21724
Technical publication announcements covering Center programs, January to March 1986
[PB87-140273] N87-21748
Materials Information for Science and Technology (MIST): Project overview
[PB87-136677] N87-21750
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[PB87-145272] N87-21751

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The aim and conduct of ALPEX N87-21486
Biosphere-Atmosphere Transfer Scheme (BATS) for the NCAR (National Center for Atmospheric Research) community climate model
[PB87-141511] N87-21530
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[PB87-137766] N87-21448
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Temporal frequency of radio emissions for the April 25, 1984 flare N87-21808
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[PB87-120531] N87-20998

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Spanish Limited Area Model (LAM) behavior in two cases of Mediterranean cyclogenesis N87-21502
Nonalpine contribution to Mediterranean cyclogenesis: Synoptic study of two cases which occurred during Alpine Experiment (ALPEX) Special Observing Period N87-21510

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Chesapeake Bay circulation survey: 1981-1983
[PB87-138194] N87-21549

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Versatile three-dimensional Hamiltonian ray-tracing program for acoustic waves in the atmosphere above irregular terrain
[PB87-115804] N87-21659

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, IDAHO FALLS, IDAHO.
LORAN-C tetroon transponder and tracking system
[PB87-116687] N87-20987

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, MADISON, WIS.
Multivariate analyses of ALPEX satellite retrievals N87-21496

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, PRINCETON, N.J.
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[DE87-005644] N87-21418
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NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).
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[NPL-MOM-80] N87-21305
The improvement and evaluation of a laser interferometer for the absolute measurement of ultrasonic displacements in the frequency range up to 15 MHz
[NPL-AC-109] N87-21311
Calculation of the effect of a point impact on an infinite elastic plate adjacent to a semi-infinite fluid
[NPL-DITC-80/86] N87-21369
The effects of curvature on the stiffness of laterally loaded rectangular plates
[NPL-DMA(A)-122] N87-21370
Automatic shape parameterisation in machine vision
[NPL-DITC-79/86] N87-21597
Data approximation by splines in one and two independent variables
[NPL-DITC-77/86] N87-21623

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Solar VLBI N87-21607
A double layer model for solar X-ray and microwave pulsations N87-21829

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[PB87-137139] N87-21527
Severe local storm warning verification: 1985
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Calculation of power-flux density levels in the 2 GHz band, phase three
[PB87-120523] N87-21230

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[PB87-131173] N87-21209
Ground-wave analysis model for MF broadcast systems
[PB87-124293] N87-21228
Algorithms used in ARROWS: Autodesign of radio relay optimum wideband systems
[PB87-126405] N87-21229
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Determination of chloride in hydraulic fluids
[AD-A176408] N87-21060
Centrifuge testing of a G compensated/pressure demand oxygen regulator
[AD-A176117] N87-21587

NAVAL AIR PROPULSION TEST CENTER, TRENTON, N.J.
High response data acquisition system N87-21189

NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY, BAY ST. LOUIS, MISS.
Effects of atmospheric water vapor on the detection of mesoscale oceanographic features from GEOSAT
[AD-A176365] N87-21597

NAVAL POSTGRADUATE SCHOOL, MONTEREY, CALIF.
Establishment of software to process global positioning satellite data obtained from TI 4100 GPS (Global Positioning System) receivers
[AD-A176793] N87-20985
Hover performance of a remotely piloted helicopter
[AD-A176587] N87-20992
Development of a mathematical model that simulates the longitudinal, and lateral-directional response of the F/A-18 for the study of flight control reconfiguration
[AD-A176333] N87-21004
Design of the digital satellite link interface for a system that detects the precursory electromagnetic emissions associated with earthquakes
[AD-A176590] N87-21023
A theoretical examination of a reentry capsule incorporating an autorotating rotor
[AD-A176854] N87-21026
Holographic investigation of metallized solid propellant combustion in a three-dimensional motor
[AD-A176140] N87-21131
Implementation of three speckle reduction filters for solid propellant combustion holograms
[AD-A176583] N87-21132
A correlation for the heat transfer coefficient in a rectangular passage containing protuberance
[AD-A176111] N87-21261
Transonic compressor blade tip flow visualization on a water table
[AD-A176592] N87-21265
Stability of the vortex motion in oscillating flow
[AD-A176629] N87-21267
Vortex motion in a stratified medium
[AD-A176729] N87-21269
The near-minimum time control of a robot arm
[AD-A176875] N87-21339
Composite service life prediction via fiber bundle testing. Evaluation of testing equipment and data acquisition system
[AD-A176835] N87-21365
Characteristics of mesoscale island barrier cloud phenomena observed in satellite and space shuttle imagery
[AD-A176628] N87-21519
Data from the Optical Dynamics Experiment (ODEX) R/V acania expedition of 10 October thru 17 November 1982. Volume 1: CTD and optics profiles (temperature, salinity, density, sound speed, optical beam attenuation, fluorescence, and dissolved oxygen)
[AD-A176289] N87-21535
Analysis of water column stability using shipboard and submarine density and shear measurements
[AD-A176589] N87-21539
A numerical method for solving for normal modes with impedance bottom
[AD-A176591] N87-21540
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA21, 7-20 July 1986
[AD-A176638] N87-21541
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA22, 27 July-5 August 1986
[AD-A176639] N87-21542
Hydrographic data from the OPTOMA (Ocean Prediction Through Observation, Modeling and Analysis) program OPTOMA20, 16 March -6 May 1986
[AD-A176795] N87-21544
Wind forcing experiments in the California current system
[AD-A176818] N87-21545
Remote sensing of ocean sediment volume reverberation
[AD-A177188] N87-21546
Real time programming of a robot
[AD-A176782] N87-21616

NAVAL RESEARCH LAB., WASHINGTON, D. C.
Hardware design for a fixed-wing airborne gravity measurement system
[AD-A176620] N87-20993
Ultimate tensile strength of pitch-based carbon fibers
[AD-A176955] N87-21118
Stability, compatibility, and related problems of additives in Naval distillate fuels derived from lower quality feedstocks
[DE87-001223] N87-21136
A quick look at the first NRL short pulse 95 GHz radar flight data
[AD-A176182] N87-21214
Phase pattern of phased array element
[AD-A176621] N87-21218
Cosmic ray effects on microelectronics. Part 4
[AD-A176611] N87-21242
Vorticity generation by shock propagation through bubbles in air
[AD-A176610] N87-21266
Modeling and experimental validation of a single-link flexible manipulator
[AD-A176614] N87-21338
Tethered balloon measurements made at Naval Air Development Center (December 1985)
[AD-A176254] N87-21517

Characteristics of the two-dimensional spectrum of roughness on a seamount
[AD-A176366] N87-21538
The interchange instability in high-latitude plasma blobs
[AD-A176242] N87-21685
The low frequency space array
[AD-A177115] N87-21758
A search for fast variations in the Fe XXI emission during solar flares N87-21811

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Effects of stresses on the phase transformation of NITINOL
[AD-A177053] N87-21090

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FY86 independent research/independent exploratory development
[AD-A176944] N87-21589

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Effective removal parameters in long-range transport models, derived from diffusion theory calculations
[ECN-187] N87-21419
Fusion technology projects
[ECN-186] N87-21689

NEW HAMPSHIRE UNIV., DURHAM.
The propagation of solar flare particles in a coronal loop N87-21826

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[AD-A176553] N87-21010

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The Taguchi approach to quality control and enhancement: A primer
[AD-A176571] N87-21364

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[AD-A177009] N87-21119

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[AD-A176984] N87-21050

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Defect and damage characterization in composite materials
[AD-A176335] N87-21047
Superlattice effects in graphite intercalation compounds
[AD-A176879] N87-21694

O

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The effect of ion damage and annealing on superconducting transition metal-nitride compounds
[DE87-005988] N87-21712

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[DE87-005960] N87-21683
Using bar code technology to enhance classified document accountability
[DE87-000760] N87-21739

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Development of alumina- and mullite-SiC whisker composites: High temperature properties
[DE87-004624] N87-21052
Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels
[DE87-004000] N87-21092
Effect of aluminum addition on ductility and yield strength of Fe3Al alloys with 0.5 wt % TiB2
[DE87-004821] N87-21098
Processing and properties of powder metallurgy Ni(sub 3)Al-Cr-Zr-B for use in oxidizing environments
[DE87-001699] N87-21101
Creep cavitation in a nickel aluminide
[DE87-004392] N87-21106
Introduction and status of the ceramic technology for advanced heat engines project
[DE87-004403] N87-21122
Viscosity behavior in supercooled pure liquids and mixtures
[DE87-004036] N87-21282
High-throughput continuous cryopump
[DE87-000396] N87-21343
A real-time expert system for control of an autonomous mobile robot and for diagnosing unexpected occurrences
[DE87-002411] N87-21345
Real-time expert system for the control of autonomous robot navigation in the presence of moving obstacles
[DE87-002167] N87-21350
Advanced manipulation for autonomous mobile robots
[DE87-002818] N87-21351
Real-time expert system for control of an autonomous mobile robot including diagnosis of unexpected occurrences
[DE87-000385] N87-21354
Manipulator Comparative Testing Program
[DE87-006026] N87-21355
Metal hydride temperature amplifiers for high temperature (260 C) applications: A parametric study
[DE87-005297] N87-21415
Hypercube Applications at Oak Ridge National Laboratory
[DE87-005891] N87-21594
Virtual-time operating-system functions for robotics application on a hypercube
[DE87-003658] N87-21618
Intelligent operating systems for autonomous robots: Real-time capabilities on a hypercube super-computer
[DE87-004076] N87-21620
Assessment of ceramic composites for multimegawatt space nuclear power systems
[DE87-005272] N87-21675
Document preparation guide
[DE86-015942] N87-21738

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[DE87-004015] N87-21393

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[ETN-87-99371] N87-20962
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[ETN-87-99376] N87-21007
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[ETN-87-99374] N87-21054
Activities report in energy science
[ETN-87-99373] N87-21165
Activities report in structures
[ETN-87-99375] N87-21166
Application of CARS thermometry to a turbulent flame N87-21175
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[ETN-87-99370] N87-21288
ONERA publications catalog 1986
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[PB87-118253] N87-21128
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[PB87-118220] N87-21754

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The representation of the Earth's gravitational potential in a spherical harmonic expansion to degree 250
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Ellipsoidal corrections to potential coefficients obtained from gravity anomaly data on the ellipsoid
[AD-A176901] N87-21435

OKLAHOMA UNIV., NORMAN.
A variational objective analysis scheme for analysis of the ALPEX data set N87-21491
Vorticity budgets for Alpine cyclogenesis with and without the forcing of terrain N87-21508
Effects of terrain height and blocking initialization on numerical simulation of Alpine lee cyclogenesis N87-21515
Improving the transfer and use of scientific and technical information: The Federal role. Volume 1: Summary and conclusions
[PB87-142915] N87-21746
Improving the transfer and use of scientific and technical information: The federal role. Volume 2: Problems and issues in the transfer and use of STI
[PB87-142923] N87-21747

OXFORD UNIV. (ENGLAND).
Interferometric measurement of strains and displacements in engine components N87-21196
A study of passage flow through a cascade of turbine blades using image plane holographic interferometry N87-21203
Wake interaction effects on the transition proces on turbine blades
[AD-A177094] N87-21272
Some computational results on size reduction in H sup inf design
[OUEL-1648/86] N87-21627

P

PACIFIC NORTHWEST LABS., RICHLAND, WASH.
Grain boundary composition effects on environmentally induced cracking of engineering materials
[DE87-006405] N87-21105

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
Effect of grain boundary structure on sensitization and corrosion of stainless steel
[AD-A176299] N87-21081
Densification of titanium powder during hot isostatic pressing
[AD-A176617] N87-21084
Investigations into the origins of the physical structure of thin films
[AD-A176943] N87-21117
Scattering matrix and finite-element approaches to study target strengths of homogeneous, composite and stiffened shells N87-21371
Stabilization and control problems in structural dynamics
[AD-A177183] N87-21389

PENNSYLVANIA UNIV., PHILADELPHIA.
Fundamentals of hardening and decohesion behavior in time-dependent cycle deformation
[DE87-003995] N87-21091

PHYSICAL DYNAMICS, INC., BELLVUE, WASH.
Development of techniques for the use of DMSP (Defense Meteorology Satellite Program) SSIE (Topside Ionospheric Plasma Monitor) data in the AWS (Air Weather Service) 4D ionosphere model
[AD-A176412] N87-21430

PHYSICAL SCIENCES, INC., ANDOVER, MASS.
Experimental and theoretical studies of laser propulsion phenomenology
[AD-A176851] N87-21315

PITTSBURGH UNIV., PA.
Multivariate analysis and its applications
[AD-A177019] N87-21637

POLYTECHNIC INST. OF NEW YORK, FARMINGDALE.
Millimeter wave generation by relativistic electron beams
[AD-A176949] N87-21245
Basic research in electronics: Joint Services Electronics Program (JSEP)
[AD-A177067] N87-21247

PRATT AND WHITNEY AIRCRAFT, EAST HARTFORD, CONN.
Laser velocimetry study of stator/rotor interactions in a multi-stage gas turbine compressor N87-21181

PRINCETON UNIV., N. J.
Evaluation of satellite sampling of the middle atmosphere using the GFDL SKYHI general circulation model N87-21422
GARP's objectives in weather prediction. Expectations and realizations N87-21472
Assessment of results from different analysis schemes N87-21482
Dynamical evolution of spherical stellar systems N87-21767

PURDUE UNIV., WEST LAFAYETTE, IND.
Computer modeling of high intensity solar cells [DE87-005970] N87-21416
The 2-4 semiconductor superlattices [AD-A177092] N87-21696

R

RADEX, INC., CARLISLE, MASS.
Fluxgate magnetometer analysis and simulation software for the Combined Release and Radiation Effects Satellite (CRRES) [AD-A176353] N87-21032

RCA ASTRO-ELECTRONICS DIV., PRINCETON, N. J.
Mars Observer: Phase 0 safety review data package [NASA-CR-180526] N87-21019

REMTECH, INC., BIRMINGHAM, ALA.
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 2 [NASA-CR-179075] N87-21014

REMTECH, INC., HUNTSVILLE, ALA.
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 1 [NASA-CR-179074] N87-21012
Orbital flight test shuttle external tank aerothermal flight evaluation, volume 3 [NASA-CR-179076] N87-21013

RENSSELAER POLYTECHNIC INST., TROY, N.Y.
Advanced B and Al combustion kinetics studies over wide temperature ranges [AD-A176828] N87-21081
An investigation of the closure conditions for two-fluid models of two-phase flow [DE87-004792] N87-21287

RESEARCH INST. FOR ROAD VEHICLES, TNO, DELFT (NETHERLANDS).
Preliminary development, head-neck simulator. Volume 1: Analysis volunteer tests [PB87-133245] N87-21553
Preliminary development head-neck simulator. Volume 2: Mathematical simulations [PB87-142196] N87-21557

RESEARCH INST. OF NATIONAL DEFENCE, LINKOEPING (SWEDEN).
Activities report of the Department of Reconnaissance and Seeker Systems [FOA-C-30433-3.1/3.2/3.3/3.4] N87-21227
Microwave measurements of snow in Davos (Switzerland), May-June 1986 [FOA-C-30437-3.2] N87-21525
Morphological transformations of binary images [FOA-30447-3.3] N87-21609
Activities report of the Information Systems Department [FOA-C-30441-3.3] N87-21745

RHODE ISLAND UNIV., KINGSTON.
The Gulf Stream dynamics experiment: Inverted echo sounder data report for the July 1982 to April 1983 deployment period [AD-A176776] N87-21543

ROCHESTER UNIV., N. Y.
Nonlinear optics with broad-band lasers [DE87-004306] N87-21319
LLE review [DE87-005865] N87-21324

ROCKWELL INTERNATIONAL CORP., GOLDEN, COLO.
Titanium-beryllium residual strain analysis: Role of deposition variables on texture and strength [DE87-006197] N87-21106
Inertia friction welding of 1100 aluminum to type 316 stainless steel [DE87-005044] N87-21347

ROCKWELL INTERNATIONAL CORP., THOUSAND OAKS, CALIF.
Laser evaporation studies [AD-A176826] N87-21313

ROLLS-ROYCE LTD., BRISTOL (ENGLAND).
The application of radiation physics and photogrammetric techniques for the diagnosis and solution of mechanical engineering problems and performance improvements in the development of aero gas turbine engines at Rolls Royce N87-21196

ROME AIR DEVELOPMENT CENTER, GRIFFISS AFB, N.Y.
Comparison of the effects of broad-band noise on speech intelligibility and voice quality ratings [AD-A176900] N87-21221

ROME UNIV. (ITALY).
Raman spectra of water in the translational and librational regions. Part 1: Study of the depolarization ratio [PREPRINT-534] N87-21071
Fluctuations in membranes with crystalline and hexatic order [PREPRINT-538] N87-21402
Study of the free oscillations of the Earth based on gravitional antenna data [NOTA-INTERNA-868] N87-21447
Introduction to the Z80 didactic assembly [NOTA-INTERNA-870] N87-21595
The gauge field copies and Backlund transformation [PREPRINT-513] N87-21632
Hierarchies of integrable equations obtained as noniospectral (in X and T) deformations of the Schroedinger spectral problem [PREPRINT-522] N87-21633
On a new Darboux transformation for the construction of exact solutions of the Schroedinger equation [PREPRINT-523] N87-21634
Nonlinear evolution equations, rescalings, model Partial Differential Equations (PDE's) and their integrability, 1 [PREPRINT-524] N87-21635
The octet nonleptonic Hamiltonian and current algebra on the lattice with Wilson fermions [PREPRINT-525] N87-21636
On the upper critical dimension in Anderson localization [PREPRINT-514] N87-21638
Intermittency as multifractality in history space [PREPRINT-518] N87-21639
The multifractal nature of strange attractors and turbulence [PREPRINT-539] N87-21640
The relevance of connectance on the Lyapunov characteristic exponents of products of symplectic random matrices [PREPRINT-519] N87-21643
Symmetries and bi-Hamiltonian structures of 2+1 dimensional systems [PREPRINT-536] N87-21644
Integrable 2+1 dimensional equations, their recursion operators and bi-Hamiltonian structures as reduction of multidimensional systems [PREPRINT-540] N87-21645
Neutral meson decays and the annihilation contribution [PREPRINT-515] N87-21666
The production of weak intermediate bosons in electron-positron reactions [PREPRINT-520] N87-21667
Light gluinos and fixed target experiments [PREPRINT-526] N87-21668
Massless Higgs boson in softly broken supersymmetric theories [PREPRINT-528] N87-21669
Status of the electroweak theory [PREPRINT-529] N87-21670
Searching for an intermediate mass Higgs boson at large energy e+e-, linear colliders [PREPRINT-530] N87-21671
Heavy Higgs production at future colliders [PREPRINT-531] N87-21672
Magnetic moments of multiquark states and limit on the six-quark bag admixture in the deuteron wave function [PREPRINT-537] N87-21673
Heat transport and effective Landau Fermi liquid parameters in disordered interacting electronic systems [PREPRINT-542] N87-21674
School and the nuclear energy problems: Preliminary analysis of a questionnaire [NOTA-INTERNA-873] N87-21678
A microscopic theory for the Brillouin intensities evaluation in noble gas crystals [PREPRINT-521] N87-21721
Evaluation of Brillouin scattering intensities from rare gas crystals. Part 1: A pure dipole induced dipole theory [PREPRINT-535] N87-21722
Gauge fixing for the field theory of the basonic string [PREPRINT-527] N87-21729
Theoretical summary [PREPRINT-532] N87-21730
Hadron phenomenology via the fire-string model [PREPRINT-533] N87-21731
The abandoned ways: Turbulence and chaos [NOTA-INTERNA-869] N87-21732

ROUEN UNIV. (FRANCE).
Numerical simulation of turbulent reactive flows [ETN-87-99398] N87-21289

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND).
Developments in air traffic control systems and their relation with meteorology [RAE-TRANS-2143] N87-20981
Aileron reversal of swept wings with crossflexibilities [RAE-TR-83023] N87-20988
Wing divergence and structural distortion [RAE-TR-85057] N87-20989
Divergence and flutter of swept-forward wings with crossflexibilities [RAE-TR-80047] N87-21000
A simplified appraisal of the pulsed performance of electrothermal hydrazine thrusters [RAE-TM-SPACE-355] N87-21033
A comparison of the fatigue performance of woven and non-woven CFRP laminates [RAE-TR-85059] N87-21041
The effects of impact damage in tapered-thickness CFRP laminates [RAE-TR-85067] N87-21045
Developments in data acquisition and processing using an advanced combustion research facility N87-21192
Inspection of complex profiles: A review of the methods available, and best suited to the needs of RAE Pyestock [RAE-TM-P-1077] N87-21306
REGIS: An RAE experimental image-based geographic information system [RAE-TR-84103] N87-21405
Original improvements of the TLM method [RAE-TRANS-2151] N87-21624

ROYAL ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT, FORT HALSTEAD (ENGLAND).
A solid state triggered switch for EBW firing circuits [RARDE-MEMO-6/86] N87-21236

ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT.
Runway Visual Range (RVR) documentation of the civil airports in the Netherlands [KNMI-TR-84] N87-20986
Numerical boundary conditions with minimal reflection for limited-area models [KNMI-WR-86-3] N87-21292
Snow depths in the Netherlands from measurements at synoptic stations in 1955 and in the period 1978-1984 [KNMI-TR-51A] N87-21522
Description of the Terschelling wind observation station for the period 1949-1980 [KNMI-TR-86] N87-21523
The atmospheric boundary layers [KNMI-TR-89] N87-21524

ROYAL SIGNALS AND RADAR ESTABLISHMENT, MALVERN (ENGLAND).
Field assisted etching [RSRE-MEMO-3715] N87-21161
Methods for thinning silicon chips [RSRE-MEMO-3952] N87-21162
A theoretical study of calibration procedures for coherent and non-coherent polarimetric radars [RSRE-86011] N87-21210
A calibrtion procedure for a coherent polarimetric radar [RSRE-MEMO-3869] N87-21211
Biological materials for integrated circuits [RSRE-MEMO-3965] N87-21237
Rapid isothermal processing systems: An overview [RSRE-MEMO-3967] N87-21238
A compiler-compiler for the SCP3 micro-program [RSRE-MEMO-3962] N87-21592
Ten 15: An overview [RSRE-MEMO-3977] N87-21599
An evaluation of the Flex programming support environment [RSRE-86003] N87-21600
Integrity and the Flex programming support environment [RSRE-MEMO-3915] N87-21601
Tabulated output from ELLA [RSRE-MEMO-3966] N87-21602
Investigation into the characteristics of ZnSe filters [RSRE-MEMO-3993] N87-21680

S

SAINT ANDREW'S UNIV. (SCOTLAND).
Impulsively generated fast coronal pulsations N87-21822

SANDIA NATIONAL LABS., ALBUQUERQUE, N. MEX.
A spatial marching technique for the inviscid blunt body problem [DE87-004526] N87-20972
Ductile iron data base. Correlations between microstructure and fracture toughness: Background document for draft ASTM ductile iron specification [DE87-006010] N87-21107

Accurate measurements of combustion species concentrations using CARS N87-21173
Sapphire fiber optic temperature probe N87-21186
Design and development of a multi-kilowatt hour hydrogen/nickel oxide battery
[DE87-006774] N87-21250
Numerical simulation of buoyant convection in vented enclosures
[DE86-012941] N87-21280
Application of a high-precision universal measuring machine in Standards Laboratory measurements
[DE87-003036] N87-21308
Phase selection during pulsed laser annealing of Fe-V alloys
[DE87-003507] N87-21318
A 1-ms electron beam facility for laser kinetic studies
[DE87-003299] N87-21323
Modeling and control of the Stanford/JPL hand
[DE87-005847] N87-21353
Multi-point transient modal testing
[DE87-003880] N87-21394
Identification of material constants for a composite shell structure
[DE87-004524] N87-21395
Computer modeling of high intensity solar cells
[DE87-005970] N87-21416
Stress release in ion implanted lattice mismatched semiconductor heterostructures
[DE87-004516] N87-21703
MBE (Molecular Beam Epitaxy) growth of strained-layer superlattice device structures
[DE87-005881] N87-21711
Kinetics and thermodynamics of quasicrystals as determined by surface modification techniques
[DE87-005538] N87-21713
Materials Information for Science and Technology (MIST): Project overview
[PB87-136677] N87-21750

SCI-TECH KNOWLEDGE SYSTEMS, SCOTIA, N.Y.
Materials Information for Science and Technology (MIST): Project overview
[PB87-136677] N87-21750

SCIENCE APPLICATIONS INTERNATIONAL CORP., MCLEAN, VA.
Handbook for using foams to control vapors from hazardous spills
[PB87-145660] N87-21421

SCIENTIFIC RESEARCH ASSOCIATES, INC., GLASTONBURY, CONN.
Solution of the three-dimensional Navier-Stokes equations for a turbulent horseshoe vortex flow
[AD-A176370] N87-21263
Numerical study of three-dimensional laminar and turbulent flows with system rotation
[AD-A176546] N87-21264
Three-dimensional numerical studies of the physics of semiconductor crystal growth
[AD-A176808] N87-21693

SEDACIP SARL, LES ULIS (FRANCE).
Original improvements of the TLM method
[RAE-TRANS-2151] N87-21624

SKIDAWAY INST. OF OCEANOGRAPHY, SAVANNAH, GA.
Biological processes in the water column of the south Atlantic bight: Phytoplankton responses
[DE87-003967] N87-21547

SMITHS INDUSTRIES LTD., BISHOPS CLEEVE (ENGLAND).
Electronic display equipment for use in the advanced flight deck simulator at British Aerospace, Weybridge
[RID-1912] N87-21005

SMITHSONIAN ASTROPHYSICAL OBSERVATORY, CAMBRIDGE, MASS.
Dust-gas interaction deduced from Halley multicolour camera observations
[DE87-003426] N87-21782

SOCIETE NATIONALE D'ETUDES ET DE CONSTRUCTION DE MOTEURS D'AVIATION, MOISSY-CRAMAYEL (FRANCE).
Acquisition and processing of non-stationary pressure measurments in studies of air intake distortion N87-21191

SOUTH CAROLINA UNIV., COLUMBIA.
Some research problems in reliability theory and in limit theory
[AD-A176439] N87-21363

SOUTHERN CALIFORNIA EDISON CO., LOS ANGELES.
LLE review
[DE87-005865] N87-21324

SOUTHERN CALIFORNIA INST. OF ARCHITECTURE, SANTA MONICA.
Space station group activities habitability module study
[NASA-CR-4010] N87-21585

SRI INTERNATIONAL CORP., MENLO PARK, CALIF.
Fracture and hardness of semiconductor alloys
[AD-A176800] N87-21088
Ordered polymers for space applications
[AD-A177108] N87-21120

STANFORD UNIV., CALIF.
Research on cryogenic vacuum tunneling
[AD-A176363] N87-21082
Research on cryogenic vacuum tunneling
[AD-A176390] N87-21662
Diffusion and defect characterization of mercury cadmium telluride
[AD-A176323] N87-21690
Rapid fluctuations in solar flares N87-21786
Sub-second variations of high energy (300 keV) hard X-ray emission from solar flares N87-21787
On the 152-day periodicity of the solar flare occurrence rate
[NASA-CR-180519] N87-21838
Classification of solar flares and relationship between the first and second phases
[NASA-CR-180221] N87-21839

STATE UNIV. OF NEW YORK, STONY BROOK.
Ultraviolet observations of Jupiter and Uranus N87-21762

STOCKHOLM UNIV. (SWEDEN).
The objectives of the Global Weather Experiment and overall view of the accomplishment of GARP N87-21471

SUMX CORP., AUSTIN, TEX.
Inhibition of localized corrosion
[AD-A176573] N87-21083

SURREY UNIV., GUILDFORD (ENGLAND).
The micromechanics of damage initiation and development under static and fatigue loading of CFRP XA-S/914 and E-glass/913 laminates
[BR-99965] N87-21044

SVERDRUP TECHNOLOGY, INC., MIDDLEBURG HEIGHTS, OHIO.
Microgravity fluid management requirements of advanced solar dynamic power systems N87-21153

SYRACUSE UNIV., N. Y.
Electromagnetic penetration into a conducting circular cylinder through a narrow slot, TM case
[AD-A176483] N87-21217

SYSTEMS AND APPLIED SCIENCES CORP., LANHAM, MD.
Quasi-periodic pulsations in solar hard X-ray and microwave flares N87-21804

SYSTEMS ENGINEERING LABS., INC., GREENBELT, MD.
Modeling and control of flexible structures
[AD-A177106] N87-21388

T

TAMPERE UNIV. OF TECHNOLOGY (FINLAND).
Application of the ALE and MBE methods to the growth of layered Hg sub 1-x Cd sub x Te films
[AD-A176797] N87-21692

TANTALUS, INC., CLEVELAND HEIGHTS, OHIO.
Application of the maximum entropy principle to retrieval from very large databases
[PB87-115523] N87-21752

TECHNICAL RESEARCH CENTRE OF FINLAND, ESPOO.
On the correlation of hardness with tensile and yield strength
[VTT-416] N87-21109
Fracture properties of ferritic, ferritic-pearlitic, pearlitic and bainitic nodular cast irons
[VTT-430] N87-21110
Submerged arc welding of high strength structural steels
[VTT-436] N87-21361
Mechanical properties of welded joints in two fine-grained steels with yield strength of 370 N/mm(sup)2
[VTT-441] N87-21399

TECHNICAL UNIV. OF DENMARK, LYNGBY.
Period three generation on microwave-induced constant-voltage steps of Josephson tunnel junctions
[DE87-003530] N87-21700

TECHNION - ISRAEL INST. OF TECH., HAIFA.
Improvement of fatigue life prediction accuracy for various realistic loading spectra by use of correction factors
[TAE-561] N87-21374

TECHNION RESEARCH AND DEVELOPMENT FOUNDATION LTD., HAIFA (ISRAEL).
Thermomechanical effects in inelastic materials and structures
[AD-A177076] N87-21386

TECHNISCHE HOCHSCHULE, AACHEN (WEST GERMANY).
Turbine rotor blade measurements using infrared pyrometry N87-21188

TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS).
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Part A: Adhesion and delamination
[ETN-87-99576] N87-21056
ARAMID reinforced aluminum laminates: ARALL adhesion problems and environmental effects. Volume B: Environmental effects on delamination
[ETN-87-99577] N87-21057
A class of integral transforms and associated function spaces
[ETN-87-99575] N87-21629
Computer generation of convergent beam electron diffraction patterns
[ETN-87-99578] N87-21719

TECHNISCHE HOGESCHOOL, EINDHOVEN (NETHERLANDS).
The electrocatalysts of dioxygen reduction on transition metal chelates
[ETN-87-99584] N87-21070
Microstructural investigation of copolymers. A key in revealing relations between polymerization conditions and polymer properties
[ETN-87-99585] N87-21127
Electrokinetic and hydrodynamic transport through porous media
[ETN-87-99581] N87-21299
Flow properties of He3 in dilute He3-He4 mixtures at temperatures between 10 and 150 mK
[ETN-87-99582] N87-21300
The absolute measuring accuracy of technical laser interferometers
[ETN-87-99580] N87-21331
Computer aided design of magnetic deflection systems
[ETN-87-99583] N87-21608
The estimation of parameters in functional relationship models
[ETN-87-99586] N87-21630
Nonequilibrium in flowing atmospheric plasmas
[ETN-87-99587] N87-21688
Analysis of the magnetic properties of semimagnetic semiconductors. An experimental study
[ETN-87-99579] N87-21720

TECHNISCHE UNIV., MUNICH (WEST GERMANY).
Numerical simulation of lee cyclogenesis during Alpine Experiment with an isentropic coordinate model N87-21504

TEL-AVIV UNIV. (ISRAEL).
The frontiers of physics (the next 25 years)
[DE87-004329] N87-21648

TENNESSEE UNIV., KNOXVILLE.
The effect of ion damage and annealing on superconducting transition metal-nitride compounds
[DE87-005988] N87-21712

TEST WING (4950TH), WRIGHT-PATTERSON AFB, OHIO.
Advanced Electromechanical Actuation System (EMAS), flight test
[AD-A176148] N87-21001

TEXAS TECHNOLOGICAL UNIV., LUBBOCK.
Failure strengths of laminated glass units
[PB87-118873] N87-21113

TEXAS UNIV., AUSTIN.
Vectorial electron transfer on designed surfaces
[PB87-144325] N87-21137
Muonic X-ray laser assisted by catalyzed fusion of deuterium and tritium
[DE87-004851] N87-21327
On the spatial structure of the acoustic signal field near the deep ocean bottom due to a near-surface cw source
[AD-A176344] N87-21536
Collisional evolution in the asteroid belt: An observational and numerical study N87-21768

TEXAS UNIV., DALLAS.
Retarding potential analyzer research
[NASA-CR-180508] N87-21427

TEXTRON BELL HELICOPTER, FORT WORTH, TEX.
Summary of the modeling and test correlations of a NASTRAN finite element vibrations model for the AH-1G helicopter, task 1
[NASA-CR-178201] N87-21373

THESSALONIKI UNIV. (GREECE).
Theoretical studies on rapid fluctuations in solar flares N87-21830

TOKYO ASTRONOMICAL OBSERVATORY, MITAKA (JAPAN).
Hard X-ray imaging observation of fluctuating bursts N87-21795
Position measurements of rapidly fluctuating microwave bursts N87-21800

TOYAMA UNIV. (JAPAN).
Signatures of current loop coalescence in solar flares N87-21827

TRANSAMERICA DELAVAL, INC., TRENTON, N.J.
Alternative flow control nozzles/energy dissipation of highly erosive fluids
[DE87-001025] N87-21273
TRW SPACE TECHNOLOGY LABS., REDONDO BEACH, CALIF.
The P/Giacobini-Zinner magnetotail
[DE87-003761] N87-21784
TUEBINGEN UNIV. (WEST GERMANY).
Evidence for beamed electrons in a limb X-ray flare observed by Hard X-Ray Imaging Spectrometer (HXIS) N87-21791
TUFTS UNIV., MEDFORD, MASS.
Elastic interactions of a crack with damage and associated energy release rates
[AD-A177071] N87-21385

U

UNITED KINGDOM ATOMIC ENERGY AUTHORITY, HARWELL (ENGLAND).
CARS thermometry for low and high pressure combustion systems N87-21172
UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CONN.
Flowfield measurements in a separated and reattached flat plate turbulent boundary layer
[NASA-CR-4052] N87-21257
UNIVERSITY OF SOUTH FLORIDA, TAMPA.
Macromodeling of digital circuits
[AD-A176874] N87-21243
UPPSALA IONOSPHERIC OBSERVATORY (SWEDEN).
Spread F: The Scandinavian scene
[UIO-SR-86-02] N87-21443

V

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Laser Doppler velocimeter measurements in a turbulent junction vortex N87-20964
Heat transfer in oscillatory flow
[DE87-004374] N87-21276
Nonlinear viscoelastic analysis of adhesively bonded joints
[AD-A176494] N87-21379
VON KARMAN INST. FOR FLUID DYNAMICS, RHODE-SAINT-GENESE (BELGIUM).
Digital image processing applied to fluid dynamic problems N87-21193
Solution of the steady state incompressible Navier-Stokes equations in curvilinear nonorthogonal coordinates
[VKI-TN-158] N87-21297
The influence of the wall boundary condition on a solution of the incompressible Navier-Stokes equation
[VKI-TM-42] N87-21298
A prediction method for the air-droplets flow in the inlet section of a natural draft cooling tower
[VKI-TM-40] N87-21301

W

WARWICK UNIV. COVENTRY (ENGLAND).
The application of holography as a transonic flow diagnostic to rotating components in turbomachinery N87-21202
WASHINGTON UNIV., ST. LOUIS, MO.
Ultrasonic cure characterization of epoxy resins: Constitutive modeling
[AD-A176661] N87-21116
Numerical modelling of cryogenic propellant behavior in low-G N87-21148
Rapid search for spherical objects in aerial photographs
[AD-A176391] N87-21406
Haze climate of the United States
[PB87-141057] N87-21529
WEA, CAMBRIDGE, MASS.
Wave-mode coordinates and scattering matrices for wave propagation
[AD-A176998] N87-21030
WEAPONS RESEARCH ESTABLISHMENT, SALISBURY (AUSTRALIA).
A solid propellant charge design with negative effective pressure exponent using forced cone burning
[WSRL-0469-TR] N87-21130
WESTINGHOUSE RESEARCH AND DEVELOPMENT CENTER, PITTSBURGH, PA.
Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels
[DE87-004000] N87-21092
Large area sheet task: Advanced dendritic web growth development
[NASA-CR-180505] N87-21417
WISCONSIN UNIV., MADISON.
Phase selection during pulsed laser annealing of Fe-V alloys
[DE87-003507] N87-21318
Full-field stress-strain analysis of cracking plates
[AD-A176996] N87-21383
Quasi-Lagrangian diagnostics of a Mediterranean cyclone: Isentropic results N87-21507
Quick look Atlantic Ocean rain maps for gale
[NASA-CR-180511] N87-21533
Vortices in long Josephson junctions
[AD-A176916] N87-21695
WITWATERSRAND UNIV., JOHANNESBURG (SOUTH AFRICA).
A literature review of the properties and uses of vanadium in engineering alloys and of vanadium carbide
[DE87-900482] N87-21096
WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS.
Abstracts of papers submitted in 1985 for publication (for Woods Hole Oceanographic Institution)
[PB87-129433] N87-21532
Technical description of an acoustic Doppler based upper ocean profiling system
[PB87-142162] N87-21551
WORLD CLIMATE PROGRAMME, GENEVA (SWITZERLAND).
Noctural topoclimatology
[WCP-117] N87-21520
Report of the workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models
[WCP-122] N87-21521
WORLD METEOROLOGICAL ORGANIZATION, GENEVA (SWITZERLAND).
Proceedings of the International Conference on the Results of the Global Weather Experiment and Their Implications for the World Weather Watch, Volume 1
[WMO-TD-107-VOL-1] N87-21470
Proceedings of the Conference on the Scientific Results of the Alpine Experiment (ALPEX), Volume 1
[WMO-TD-VOL-1] N87-21485
WYOMING UNIV., LARAMIE.
Laboratory simulation of rotating stratified flow over and around the Alps N87-21516

Y

YORK UNIV. (ENGLAND).
Progress toward predicting high-voltage charging of spacecraft in low polar orbit
[AD-A176939] N87-21027

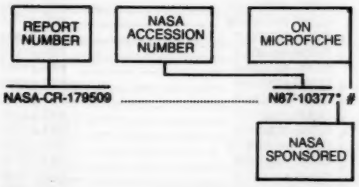
Typical Contract Number Index Listing

Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

AF-AFOSR-84-0125 ..... N87-21051
AF-AFOSR-0019-86 ..... N87-21061
AF-AFOSR-0025-86 ..... N87-21695
AF-AFOSR-0032-85 ..... N87-21271
AF-AFOSR-0042-84 ..... N87-21386
AF-AFOSR-0107-84 ..... N87-21029
AF-AFOSR-0108-82 ..... N87-20971
AF-AFOSR-0149-84 ..... N87-21117
AF-AFOSR-0185-85 ..... N87-21696
AF-AFOSR-0234-85 ..... N87-21222
AF-AFOSR-0253-85 ..... N87-21389
AF-AFOSR-0254-84 ..... N87-21382
AF-AFOSR-0295-85 ..... N87-21272
AF-AFOSR-0316-85 ..... N87-21245
AF-AFOSR-0321-84 ..... N87-21385
AF-AFOSR-0323-85 ..... N87-21681
AF-AFOSR-0328-85 ..... N87-21383
AF-AFOSR-0365-85 ..... N87-21316
AFOSR-ISSA-85-0026 ..... N87-21302
D/ERI/9/4/2064/066-XR/MAT N87-21044
DA PROJ. 1L1-61102-BH-57 ..... N87-21049
N87-21387
DA PROJ. 2Q2-63731-A-792 ..... N87-21586
DA PROJ. 2Q2-63739-A-793 ..... N87-21586
DA PROJ. 3E1-62777-A-879 ..... N87-21555
DAAG29-82-C-0012 ..... N87-21138
DAAG29-82-C-0021 ..... N87-21264
DAAG29-83-C-0024 ..... N87-21083
DAAG29-83-C-0026 ..... N87-21691
DAAG29-83-K-0037 ..... N87-21615
DAAG29-83-K-0107 ..... N87-21048
DAAG29-83-K-0149 ..... N87-21115
DAAG29-84-K-0006 ..... N87-21219
DAAG29-84-K-0078 ..... N87-21217
DAAG29-85-C-0027 ..... N87-21042
DAAG29-85-K-0183 ..... N87-21216
DAAK11-85-C-0012 ..... N87-21262
DAAL03-86-K-0010 ..... N87-21363
DAAL03-86-K-0039 ..... N87-21364
DAJA45-83-C-0019 ..... N87-21387
DAJA45-84-C-0051 ..... N87-21692
DAJA45-85-C-0025 ..... N87-21049
DAMD17-81-C-1023 ..... N87-21555
DARPA ORDER 5019 ..... N87-21690
DE-AC01-84CE-90142 ..... N87-21254
DE-AC02-76CH-00016 ..... N87-21548
N87-21697
N87-21698
N87-21699
N87-21702
N87-21773
DE-AC02-76CH-03000 ..... N87-21778
N87-21779
DE-AC02-76ER-03077 ..... N87-21286
DE-AC02-80ER-10774 ..... N87-21842
DE-AC02-81ER-10979 ..... N87-21319
DE-AC02-83CH-10093 ..... N87-21285
DE-AC02-83ER-45025 ..... N87-21714
DE-AC03-76SF-00098 ..... N87-21093
N87-21104
N87-21392
N87-21700
N87-21701
DE-AC04-76DP-00053 ..... N87-21164
N87-21390
DE-AC04-76DP-00613 ..... N87-21125
DE-AC04-76DP-00789 ..... N87-20972
N87-21107
N87-21250
N87-21280
N87-21306
N87-21318
N87-21323
N87-21353
N87-21394
N87-21396
N87-21416
N87-21703
N87-21711
N87-21713
DE-AC04-76DP-03533 ..... N87-21106
N87-21347
DE-AC05-76OR-00033 ..... N87-21712
DE-AC05-84OR-21400 ..... N87-21052
N87-21092
N87-21096
N87-21101
N87-21106
N87-21122
N87-21343
N87-21345
N87-21350
N87-21351
N87-21354
N87-21355
N87-21415
N87-21594
N87-21618
N87-21620
N87-21675
N87-21738
DE-AC05-84OS-21400 ..... N87-21393
DE-AC05-84OT-21400 ..... N87-21663
N87-21739
DE-AC06-76FF-02170 ..... N87-21102
DE-AC06-76RL-01830 ..... N87-21105
DE-AC07-76ID-01570 ..... N87-21053
N87-21100
N87-21366
DE-AC08-82DP-40152 ..... N87-21325
DE-AC08-83NV-10282 ..... N87-21682
N87-21686
DE-AC09-76SR-00001 ..... N87-21346
N87-21352
N87-21619
N87-21740
DE-AC21-84MC-21186 ..... N87-21414
DE-AC21-86MC-22250 ..... N87-21273
DE-AI05-83ER-60113 ..... N87-21418
DE-AI05-85ER-40240 ..... N87-21715
DE-AS04-85AL-31881 ..... N87-21063
DE-AS05-82ER-12022 ..... N87-21276
DE-FC08-85DP-40200 ..... N87-21324
DE-FC22-83FE-60149 ..... N87-21135
N87-21136
DE-FG01-85CE-90234 ..... N87-21278
DE-FG02-85ER-13442 ..... N87-21075
N87-21760
DE-FG02-85ER-45179 ..... N87-21095
DE-FG02-85ER-45188 ..... N87-21091
DE-FG02-85ER-45205 ..... N87-21103
DE-FG02-86ER-13489 ..... N87-21287
DE-FG02-86ER-13553 ..... N87-21066
DE-FG02-86ER-45250 ..... N87-21709
DE-FG02-86ER-45255 ..... N87-21097
DE-FG03-86ER-45232 ..... N87-21064
DE-FG05-80ET-53088 ..... N87-21327
DE-FG05-85ER-13326 ..... N87-21646
DE-FG05-85ER-13357 ..... N87-21321
DE-FG05-85ER-25008 ..... N87-21593
N87-21598
DE-FG05-85ER-40200 ..... N87-21648
DE-FG09-85ER-60353 ..... N87-21547
DE-FG22-83PC-60607 ..... N87-21065
DMA800-85-C-0010 ..... N87-21406
DRET-84-34-003 ..... N87-21309
DRET-84-173 ..... N87-21289
DRET-84-355 ..... N87-21294
N87-21295
N87-21296
DTFA01-84-Z-2-02030 ..... N87-21603
DTFH61-83-C-00041 ..... N87-21167
EMRM-82-0437 ..... N87-21597
EPA-R-180351 ..... N87-21529
EPA-68-03-3113 ..... N87-21421
FMV:FFL-82250-85-078-73-001 ..... N87-20994
N87-21401
FOA-310775 ..... N87-21443
F04611-85-C-0054 ..... N87-21133
F04701-85-C-0086 ..... N87-21024
N87-21048
N87-21062
N87-21215
N87-21312
N87-21314
F19628-83-C-0105 ..... N87-21032
F19628-83-C-0106 ..... N87-21430
F19628-83-K-0028 ..... N87-21027
F19628-85-K-0051 ..... N87-21436
F19628-86-K-0016 ..... N87-21431
N87-21435
F30602-81-C-0202 ..... N87-21243
F30602-84-C-0032 ..... N87-21362
F33615-82-C-0002 ..... N87-20995
F33615-83-C-1023 ..... N87-21340
F33615-83-C-2317 ..... N87-21121
F33615-84-C-2412 ..... N87-21342
F33615-84-C-3216 ..... N87-21378
F33615-84-C-5030 ..... N87-21060
F33615-85-C-2504 ..... N87-21246
F49620-80-C-0043 ..... N87-21270
F49620-81-C-0091 ..... N87-21434
F49620-82-C-0076 ..... N87-21119
N87-21694
F49620-83-K-0036 ..... N87-21120
F49620-84-C-0007 ..... N87-20970
F49620-84-C-0018 ..... N87-21835
F49620-84-C-0077 ..... N87-21050
F49620-84-C-0091 ..... N87-21313
F49620-84-C-0115 ..... N87-21386
F49620-85-C-0006 ..... N87-21637
F49620-85-C-0018 ..... N87-21341
F49620-85-C-0068 ..... N87-21244
F49620-85-C-0072 ..... N87-21315
F49620-85-C-0078 ..... N87-21247
F49620-85-C-0107 ..... N87-20957
N87-20958
N87-20959
N87-20960
N87-20961
N87-20984
F49620-85-C-0125 ..... N87-21163
F49620-85-C-0148 ..... N87-21030
F49620-85-K-0023 ..... N87-21068
F49620-86-C-0002 ..... N87-21025
F49620-86-C-0007 ..... N87-21437
F49620-86-C-0014 ..... N87-21089
GRI-5082-260-0756 ..... N87-21137
JPL-956289 ..... N87-21411
JPL-956312 ..... N87-21412
JPL-956831 ..... N87-21413
JPL-957444 ..... N87-21019
MDA903-81-C-0504 ..... N87-21586
MOD(PE)-A81A/1992 ..... N87-21005
NAGW-78 ..... N87-21821
NAGW-91 ..... N87-21821
NAGW-92 ..... N87-21786
NAGW-93 ..... N87-21789
NAGW-294 ..... N87-21789
NAGW-589 ..... N87-21789
NAGW-726 ..... N87-21781
NAG2-250 ..... N87-21554
NAG3-167 ..... N87-20996
NAG3-260 ..... N87-20996
NAG5-305 ..... N87-21427
NAG5-407 ..... N87-21625
NAG5-511 ..... N87-21833

NAG5-618 ..... N87-21769
NAG5-742 ..... N87-21533
NAS-7-100 ..... N87-21417
NASA ORDER S-21145-D N87-21834
NASA ORDER S-30544-D N87-21764
NASA ORDER W-15367 ..... N87-21811
NASW-3603 ..... N87-21828
NASW-4004 ..... N87-21307
NAS1-16610 ..... N87-21020
NAS1-17032 ..... N87-21429
NAS1-17496 ..... N87-21373
NAS1-18107 ..... N87-21259
N87-21613
NAS3-22770 ..... N87-21257
NAS3-24801 ..... N87-21212
N87-21213
NAS5-27613 ..... N87-21815
NAS8-33373 ..... N87-21012
N87-21013
N87-21014
NAS8-35054 ..... N87-21015
N87-21016
N87-21017
NAS8-35978 ..... N87-21140
NAS8-37296 ..... N87-21034
N87-21035
N87-21036
NA85AA-D-SG016 ..... N87-21531
NCC2-347 ..... N87-21584
NCC2-356 ..... N87-21585
NCC2-418 ..... N87-20965
NCC2-434 ..... N87-21011
NGL-05-020-272 ..... N87-21786
N87-21838
N87-21839
NGL-16-001-043 ..... N87-21684
NGL12-001-57 ..... N87-21763
NGR-21-002-199 ..... N87-21833
NGT-36-027805 ..... N87-21129
NSF ATM-80-18173 ..... N87-21516
NSF ATM-81-10678 ..... N87-21507
NSF ATM-82-17015 ..... N87-21530
NSF ATM-82-18488 ..... N87-21516
NSF ATM-83-12720 ..... N87-21788
NSF ATM-83-14511 ..... N87-21826
NSF ATM-84-15793 ..... N87-21810
NSF ATM-84-17654 ..... N87-21491
N87-21508
N87-21515
NSF ATM-85-05475 ..... N87-21789
NSF CBT-82-11713 ..... N87-21303
NSF DMR-85-14838 ..... N87-21402
NSF IST-83-18360 ..... N87-21752
NSF OCE-82-01222 ..... N87-21543
NSF OCE-84-00128 ..... N87-21551
NSF OCE-84-16197 ..... N87-21551
NSF PH4-85-1040 ..... N87-21646
NSF-ATM-82-17015 ..... N87-21837
NSG-2010 ..... N87-21426
NSG-7406 ..... N87-21810
NSG7-055 ..... N87-21788
N00014-80-C-0700 ..... N87-21010
N00014-80-C-0730 ..... N87-21655
N00014-82-K-0185 ..... N87-21379
N00014-82-K-0572 ..... N87-21047
N00014-83-C-0510 ..... N87-21693
N00014-83-K-0030 ..... N87-21087
N00014-83-K-0125 ..... N87-21604
N00014-84-K-0201 ..... N87-21081
N00014-84-K-0423 ..... N87-21690
N00014-84-K-0549 ..... N87-21082
N87-21662
N00014-85-C-0420 ..... N87-21263
N00014-85-G-0233 ..... N87-21596
N00014-85-K-0111 ..... N87-21786
N87-21838
N87-21839
N00014-85-K-0596 ..... N87-21364
N00014-85-K-0795 ..... N87-21116
N00014-86-F-0049 ..... N87-21449
N87-21836
N00014-86-K-0381 ..... N87-21085
N00014-084-K-0381 ..... N87-21084
N00019-80-G-00607 ..... N87-20997
N00024-86-C-6134 ..... N87-21536
N60530-85-C-0191 ..... N87-20966
N62269-82-D-0131 ..... N87-21588
PROJ. WR0-4210 ..... N87-21588
W-31-109-ENG-38 ..... N87-21123
N87-21248
N87-21367
N87-21706
W-7405-ENG-36 ..... N87-21094
N87-21124
N87-21223
N87-21251
N87-21275
N87-21322
N87-21326
N87-21328
N87-21329
N87-21344
N87-21391
N87-21440
N87-21686
N87-21704
N87-21705
N87-21725
N87-21765
N87-21772
N87-21774
N87-21775
N87-21776
N87-21782
N87-21783
N87-21784
N87-21841
W-7405-ENG-48 ..... N87-21224
N87-21252
N87-21274
N87-21279
N87-21281
N87-21283
N87-21284
N87-21317
N87-21320
N87-21330
N87-21348
N87-21438
N87-21642
N87-21757
N87-21771
W-31109-ENG-38 ..... N87-21099
N87-21249
N87-21706
N87-21707
N87-21710
168-36-53-01 ..... N87-21824
482-52-21 ..... N87-21585
482-53-53-38 ..... N87-21020
505-31-21 ..... N87-20966
N87-21006
505-40-11 ..... N87-20967
505-40-31 ..... N87-20990
505-60-01-02 ..... N87-20968
505-62-21 ..... N87-20996
505-63-01 ..... N87-21043
505-63-01-05 ..... N87-21377
505-63-11 ..... N87-21375
505-63-21-06 ..... N87-21376
505-63-51-01 ..... N87-21373
505-66-11 ..... N87-20982
505-68-01 ..... N87-21077
505-90-01 ..... N87-21078
505-90-21-01 ..... N87-21259
N87-21613
506-41-31 ..... N87-21756
506-42-31 ..... N87-21037
506-44-21 ..... N87-21239
506-49-3B N87-21141
506-49-21 ..... N87-21021
533-02-51 ..... N87-20991
535-05-01 ..... N87-21257
650-60-26 ..... N87-21212
N87-21213
665-10-40-04 ..... N87-21429
674-22-05 ..... N87-21129

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The NASA accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-85392 ..... N87-21006* #
A-86242 ..... N87-20990* #
A-86283 ..... N87-20982* #
A-86368 ..... N87-20967* #

ACCN-73371 ..... N87-21598 #
ACCN-73823 ..... N87-21647 #

ACIV/348/85 ..... N87-21743 #

AD-A167690 ..... N87-21062 #
AD-A176099 ..... N87-21586 #
AD-A176111 ..... N87-21261 #
AD-A176116 ..... N87-21843 #
AD-A176117 ..... N87-21587 #
AD-A176128 ..... N87-21362 #
AD-A176133 ..... N87-21378 #
AD-A176140 ..... N87-21131 #
AD-A176148 ..... N87-21001 #
AD-A176171 ..... N87-21555 #
AD-A176182 ..... N87-21214 #
AD-A176191 ..... N87-20997 #
AD-A176194 ..... N87-21046 #
AD-A176205 ..... N87-21002 #
AD-A176206 ..... N87-21003 #
AD-A176211 ..... N87-21079 #
AD-A176218 ..... N87-20983 #
AD-A176232 ..... N87-21080 #
AD-A176242 ..... N87-21685 #
AD-A176254 ..... N87-21517 #
AD-A176289 ..... N87-21535 #
AD-A176295 ..... N87-21215 #
AD-A176297 ..... N87-21262 #
AD-A176299 ..... N87-21081 #
AD-A176323 ..... N87-21690 #
AD-A176333 ..... N87-21004 #
AD-A176335 ..... N87-21047 #
AD-A176344 ..... N87-21536 #
AD-A176353 ..... N87-21032 #
AD-A176363 ..... N87-21082 #
AD-A176365 ..... N87-21537 #
AD-A176366 ..... N87-21538 #
AD-A176368 ..... N87-21603 #
AD-A176370 ..... N87-21263 #
AD-A176376 ..... N87-20969 #
AD-A176380 ..... N87-21662 #
AD-A176391 ..... N87-21406 #
AD-A176405 ..... N87-21216 #
AD-A176406 ..... N87-21060 #
AD-A176408 ..... N87-21115 #
AD-A176412 ..... N87-21430 #
AD-A176417 ..... N87-21655 #
AD-A176430 ..... N87-20978 #
AD-A176438 ..... N87-21336 #
AD-A176439 ..... N87-21363 #
AD-A176445 ..... N87-21691 #
AD-A176464 ..... N87-21337 #
AD-A176466 ..... N87-21588 #
AD-A176474 ..... N87-21048 #
AD-A176476 ..... N87-21604 #
AD-A176479 ..... N87-21431 #
AD-A176482 ..... N87-21615 #
AD-A176483 ..... N87-21217 #
AD-A176494 ..... N87-21379 #
AD-A176508 ..... N87-20957 #
AD-A176509 ..... N87-20958 #
AD-A176510 ..... N87-20959 #
AD-A176511 ..... N87-20960 #
AD-A176514 ..... N87-20995 #
AD-A176516 ..... N87-21626 #
AD-A176525 ..... N87-21240 #
AD-A176538 ..... N87-21022 #
AD-A176539 ..... N87-21380 #
AD-A176543 ..... N87-21518 #
AD-A176546 ..... N87-21264 #
AD-A176548 ..... N87-21381 #
AD-A176553 ..... N87-21010 #
AD-A176554 ..... N87-20979 #
AD-A176558 ..... N87-21556 #
AD-A176571 ..... N87-21364 #
AD-A176573 ..... N87-21083 #
AD-A176578 ..... N87-21432 #
AD-A176579 ..... N87-20984 #
AD-A176583 ..... N87-21132 #
AD-A176587 ..... N87-20992 #
AD-A176589 ..... N87-21539 #
AD-A176590 ..... N87-21023 #
AD-A176591 ..... N87-21540 #
AD-A176592 ..... N87-21265 #
AD-A176607 ..... N87-21241 #
AD-A176610 ..... N87-21266 #
AD-A176611 ..... N87-21242 #
AD-A176614 ..... N87-21338 #
AD-A176617 ..... N87-21084 #
AD-A176618 ..... N87-21770 #
AD-A176620 ..... N87-20993 #
AD-A176621 ..... N87-21218 #
AD-A176624 ..... N87-21407 #
AD-A176627 ..... N87-21085 #
AD-A176628 ..... N87-21519 #
AD-A176629 ..... N87-21267 #
AD-A176632 ..... N87-21219 #
AD-A176638 ..... N87-21541 #
AD-A176639 ..... N87-21542 #
AD-A176640 ..... N87-21086 #
AD-A176645 ..... N87-21087 #
AD-A176655 ..... N87-21268 #
AD-A176661 ..... N87-21116 #
AD-A176662 ..... N87-21433 #
AD-A176690 ..... N87-21042 #
AD-A176711 ..... N87-20961 #
AD-A176721 ..... N87-21220 #
AD-A176722 ..... N87-21753 #
AD-A176729 ..... N87-21269 #
AD-A176776 ..... N87-21543 #
AD-A176778 ..... N87-21133 #
AD-A176782 ..... N87-21616 #
AD-A176793 ..... N87-20985 #
AD-A176795 ..... N87-21544 #
AD-A176797 ..... N87-21692 #
AD-A176800 ..... N87-21088 #
AD-A176803 ..... N87-21163 #
AD-A176804 ..... N87-21434 #
AD-A176808 ..... N87-21693 #
AD-A176815 ..... N87-21024 #
AD-A176818 ..... N87-21545 #
AD-A176820 ..... N87-21025 #
AD-A176826 ..... N87-21313 #
AD-A176828 ..... N87-21061 #
AD-A176835 ..... N87-21365 #
AD-A176839 ..... N87-21681 #
AD-A176843 ..... N87-21314 #
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APR-1 ..... N87-21086 #

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AR-1 ..... N87-21695 #
AR-2 ..... N87-21313 #
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AR-004-859 ..... N87-21130 #
AR-005-102 ..... N87-21009 #
AR-005-103 ..... N87-21008 #

ARE-TM(UDP)-86102 ..... N87-21598 #

ARE-TM(UHA)-86518 ..... N87-21654 #

ARE-TR-86113 ..... N87-21647 #

ARI-RN-86-97 ..... N87-21586 #

ARL-AERO-PROP-REPT-172 ..... N87-21260 #

ARL-SYS-TM-88 ..... N87-21002 #

ARL-TR-86-34 ..... N87-21536 #

ARL/AERO-PROP-TM-436 ..... N87-21003 #

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ARO-20678.15-CH ..... N87-21115 #
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ARO-21378.8-EL ..... N87-21217 #
ARO-22634.4-EL ..... N87-21216 #
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ARO-22835.1-MA ..... N87-21364 #
ARO-23448.3-MA ..... N87-21363 #

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ASIAC-665.1D ..... N87-21378 #

ASR-1 ..... N87-21272 #

ATC-139 ..... N87-21603 #

ATR-1 ..... N87-21088 #

AWRE-O-9/86 ..... N87-21258 #

BARC-1305 ..... N87-21349 #

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BM-RI-9039 ..... N87-21733 #

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CAP-512 ..... N87-20975
CAP-513 ..... N87-20976
CAP-516 ..... N87-20977
CAP-519 ..... N87-21583
CAP-520 ..... N87-20954

CAS/ESM-86-4 ..... N87-21379 #

CESAR-86/52 ..... N87-21351 #

CHASEINC/CR87-11(ONR) ..... N87-21655 #

CMU-RI-TR-86-14 ..... N87-21337 #
CMU-RI-TR-86-17 ..... N87-21626 #

CNRS-ORDER-956 ..... N87-21356 #
CNRS-ORDER-959 ..... N87-21357 #
CNRS-ORDER-3373 ..... N87-21718 #

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CONF-860856-11 ..... N87-21367 #
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CSSA-ASTRO-86-37 ..... N87-21839* #

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D/M-172 ..... N87-21607 #

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DFVLR-MITT-85-04 ..... N87-21453 #

DMI-GEOPHYS-PAPERS-R-73 ..... N87-21446 #

DOE/AL-31881/1 ..... N87-21063 #

DOE/CE-90234/T1 ..... N87-21278 #

DOE/DP-40200/24-VOL-26 ..... N87-21324 #

DOE/ER-03077/277 ..... N87-21286 #
DOE/ER-10774/7 ..... N87-21842 #
DOE/ER-10979/13 ..... N87-21319 #
DOE/ER-12022/1 ..... N87-21276 #
DOE/ER-13357/5 ..... N87-21321 #
DOE/ER-13489/1 ..... N87-21287 #
DOE/ER-13553/1 ..... N87-21066 #
DOE/ER-25008/T1 ..... N87-21593 #
DOE/ER-4[illegible]200/054 ..... N87-21648 #
DOE/ER-40240/1 ..... N87-21715 #
DOE/ER-45025/14 ..... N87-21714 #
DOE/ER-45168/2 ..... N87-21091 #
DOE/ER-45205/2 ..... N87-21103 #
DOE/ER-45232/1 ..... N87-21064 #
DOE/ER-45250/1 ..... N87-21709 #
DOE/ER-45255/1 ..... N87-21097 #
DOE/ER-60113/3 ..... N87-21418 #
DOE/ER-60353/2 ..... N87-21547 #

DOE/ET-53088/255 ..... N87-21327 #

DOE/JPL-956289-86/1 ..... N87-21411* #
DOE/JPL-956312/15 ..... N87-21412* #
DOE/JPL-956831-81/1 ..... N87-21413* #
DOE/JPL-957207-86-1 ..... N87-21417* #

DOE/MC-21186/2260 ..... N87-21414 #
DOE/MC-22250/2215 ..... N87-21273 #

DOE/OR-00033/T280 ..... N87-21712 #

DOE/PC-80807/T11 ..... N87-21065 #

DOT-HS-807-034 ..... N87-21553 #
DOT-HS-807-035 ..... N87-21557 #

DOT/FAA/CT-86/11 ..... N87-21134 #

DOT/FAA/PM-86-37 ..... N87-21603 #

DP-MS-86-85 ..... N87-21619 #
DP-MS-86-137 ..... N87-21[illegible]2 #
DP-MS-86-184 ..... N87-21352 #
DP-MS-86-185 ..... N87-21346 #

DRD-SE-4 ..... N87-21413* #

DREO-TN-86-10 ..... N87-20978 #

DREO-926 ..... N87-21336 #

DRIC-T-7783 ..... N87-21059 #

DRL-216 ..... N87-21413* #

D180-28576-2-PH-1 ..... N87-21246 #

E-3254 ..... N87-21257* #
E-3305 ..... N87-21077* #
E-3386 ..... N87-21141* #
E-3416 ..... N87-21230* #
E-3442 ..... N87-21078* #
E-3451 ..... N87-20996* #
E-3472 ..... N87-21043* #
E-3485 ..... N87-21756* #
E-3524 ..... N87-21037* #
E-3528 ..... N87-21375* #

EAT-8602/CB-JMB-PW/NT ..... N87-21301 #

ECL-86-09 ..... N87-21358 #
ECL-86-06 ..... N87-21396 #
ECL-86-07 ..... N87-21716 #
ECL-86-08 ..... N87-21397 #
ECL-86-10 ..... N87-21055 #
ECL-86-11 ..... N87-21359 #
ECL-86-12 ..... N87-21717 #
ECL-86-13 ..... N87-21360 #
ECL-86-15 ..... N87-21069 #
ECL-86-16 ..... N87-21291 #

ECN-185 ..... N87-21689 #
ECN-187 ..... N87-21419 #

EGG-M-11186 ..... N87-21368 #
EGG-M-18286 ..... N87-21100 #
EGG-M-20586 ..... N87-21053 #

EGG-10282-5022 ..... N87-21682 #

EI-278-R518 ..... N87-21020* #

EI87-0403 ..... N87-21011* #

ENST-86E008 ..... N87-21225 #
ENST-86E009 ..... N87-21226 #

EPA-600/D-86-242 ..... N87-21166 #
EPA-600/3-86-060 ..... N87-20967 #
EPA-600/4-86-006 ..... N87-21074 #
EPA-600/8-86-019 ..... N87-21421 #

EPA/SW/DK-87/005A ..... N87-21612 #

EPA/600/3-86/071 ..... N87-21529 #

ESA-BR-24 ..... N87-21766 #

ESA-TT-945 ..... N87-21453 #

ESA-TT-998 ..... N87-20974 #

ESN-41-2 ..... N87-21843 #

ETN-87-99177 ..... N87-21470 #
ETN-87-99179 ..... N87-21485 #
ETN-87-99181 ..... N87-21520 #
ETN-87-99183 ..... N87-21521 #
ETN-87-99262 ..... N87-21292 #
ETN-87-99265 ..... N87-21522 #
ETN-87-99267 ..... N87-20986 #
ETN-87-99269 ..... N87-21523 #
ETN-87-99272 ..... N87-21524 #
ETN-87-99282 ..... N87-21741 #
ETN-87-99283 ..... N87-21408 #
ETN-87-99285 ..... N87-21621 #
ETN-87-99286 ..... N87-21605 #
ETN-87-99287 ..... N87-21606 #
ETN-87-99293 ..... N87-21734 #
ETN-87-99296 ..... N87-21622 #
ETN-87-99298 ..... N87-21656 #
ETN-87-99299 ..... N87-21657 #
ETN-87-99330 ..... N87-21628 #
ETN-87-99331 ..... N87-21607 #
ETN-87-99334 ..... N87-21614 #
ETN-87-99337 ..... N87-21293 #
ETN-87-99354 ..... N87-21253 #
ETN-87-99359 ..... N87-21109 #
ETN-87-99360 ..... N87-21110 #
ETN-87-99361 ..... N87-21361 #
ETN-87-99362 ..... N87-21399 #
ETN-87-99365 ..... N87-21441 #
ETN-87-99366 ..... N87-21442 #
ETN-87-99368 ..... N87-21844 #
ETN-87-99369 ..... N87-21845 #
ETN-87-99370 ..... N87-21288 #
ETN-87-99371 ..... N87-20962 #
ETN-87-99372 ..... N87-20973 #
ETN-87-99373 ..... N87-21165 #
ETN-87-99374 ..... N87-21054 #
ETN-87-99375 ..... N87-21166 #
ETN-87-99376 ..... N87-21007
ETN-87-99379 ..... N87-21735
ETN-87-99389 ..... N87-21126 #
ETN-87-99393 ..... N87-21309 #
ETN-87-99395 ..... N87-21294 #
ETN-87-99396 ..... N87-21295 #
ETN-87-99397 ..... N87-21296 #
ETN-87-99398 ..... N87-21289 #
ETN-87-99402 ..... N87-21225 #
ETN-87-99403 ..... N87-21226 #
ETN-87-99406 ..... N87-21067 #
ETN-87-99407 ..... N87-21068 #
ETN-87-99408 ..... N87-21290 #
ETN-87-99409 ..... N87-21687 #
ETN-87-99410 ..... N87-21718 #
ETN-87-99411 ..... N87-21356 #
ETN-87-99412 ..... N87-21357 #
ETN-87-99413 ..... N87-21396 #
ETN-87-99414 ..... N87-21716 #
ETN-87-99415 ..... N87-21397 #
ETN-87-99416 ..... N87-21358 #
ETN-87-99417 ..... N87-21055 #
ETN-87-99418 ..... N87-21359 #
ETN-87-99419 ..... N87-21717 #
ETN-87-99420 ..... N87-21360 #
ETN-87-99421 ..... N87-21069 #
ETN-87-99422 ..... N87-21291 #
ETN-87-99426 ..... N87-21453 #
ETN-87-99429 ..... N87-20974 #
ETN-87-99431 ..... N87-21766 #
ETN-87-99435 ..... N87-21443 #
ETN-87-99436 ..... N87-21444 #
ETN-87-99437 ..... N87-21445 #
ETN-87-99443 ..... N87-21400 #
ETN-87-99444 ..... N87-20994 #
ETN-87-99445 ..... N87-21401 #
ETN-87-99446 ..... N87-21398 #
ETN-87-99449 ..... N87-21297 #
ETN-87-99450 ..... N87-21298 #
ETN-87-99451 ..... N87-21446 #
ETN-87-99453 ..... N87-21114 #
ETN-87-99454 ..... N87-21044 #
ETN-87-99455 ..... N87-21005 #
ETN-87-99458 ..... N87-21627 #
ETN-87-99461 ..... N87-21258 #
ETN-87-99462 ..... N87-21236 #
ETN-87-99463 ..... N87-21647 #
ETN-87-99464 ..... N87-21598 #
ETN-87-99465 ..... N87-21654 #
ETN-87-99466 ..... N87-21059 #
ETN-87-99467 ..... N87-21405 #
ETN-87-99468 ..... N87-21041 #
ETN-87-99469 ..... N87-21033 #
ETN-87-99471 ..... N87-21306 #
ETN-87-99472 ..... N87-21237 #
ETN-87-99473 ..... N87-21238 #
ETN-87-99474 ..... N87-21599 #
ETN-87-99475 ..... N87-21623
ETN-87-99476 ..... N87-21031 #
ETN-87-99477 ..... N87-21409 #
ETN-87-99497 ..... N87-20975
ETN-87-99498 ..... N87-20976
ETN-87-99499 ..... N87-20977
ETN-87-99500 ..... N87-21563
ETN-87-99501 ..... N87-20954
ETN-87-99507 ..... N87-21742 #
ETN-87-99509 ..... N87-21743 #
ETN-87-99575 ..... N87-21629 #
ETN-87-99576 ..... N87-21056 #
ETN-87-99577 ..... N87-21057 #
ETN-87-99578 ..... N87-21719 #
ETN-87-99579 ..... N87-21720 #
ETN-87-99580 ..... N87-21331 #
ETN-87-99581 ..... N87-21299 #
ETN-87-99582 ..... N87-21300 #
ETN-87-99583 ..... N87-21608 #
ETN-87-99584 ..... N87-21070 #
ETN-87-99585 ..... N87-21127 #
ETN-87-99586 ..... N87-21630 #
ETN-87-99587 ..... N87-21688 #
ETN-87-99592 ..... N87-21663 #
ETN-87-99593 ..... N87-21664 #
ETN-87-99594 ..... N87-21676 #
ETN-87-99595 ..... N87-21726 #
ETN-87-99596 ..... N87-21310 #
ETN-87-99597 ..... N87-21727 #
ETN-87-99598 ..... N87-21728 #
ETN-87-99603 ..... N87-21744 #
ETN-87-99604 ..... N87-21689 #
ETN-87-99605 ..... N87-21419 #
ETN-87-99650 ..... N87-21677 #
ETN-87-99652 ..... N87-21631 #
ETN-87-99654 ..... N87-21665 #
ETN-87-99730 ..... N87-21632 #
ETN-87-99731 ..... N87-21638 #
ETN-87-99732 ..... N87-21666 #
ETN-87-99733 ..... N87-21639 #
ETN-87-99734 ..... N87-21643 #
ETN-87-99735 ..... N87-21667 #
ETN-87-99736 ..... N87-21721 #
ETN-87-99737 ..... N87-21633 #
ETN-87-99738 ..... N87-21634 #
ETN-87-99739 ..... N87-21635 #
ETN-87-99740 ..... N87-21636 #
ETN-87-99741 ..... N87-21668 #
ETN-87-99742 ..... N87-21729 #
ETN-87-99743 ..... N87-21669 #
ETN-87-99744 ..... N87-21670 #
ETN-87-99745 ..... N87-21671 #
ETN-87-99746 ..... N87-21672 #
ETN-87-99747 ..... N87-21730 #
ETN-87-99748 ..... N87-21731 #
ETN-87-99749 ..... N87-21071 #
ETN-87-99750 ..... N87-21722 #
ETN-87-99751 ..... N87-21644 #
ETN-87-99752 ..... N87-21673 #
ETN-87-99753 ..... N87-21402 #
ETN-87-99754 ..... N87-21640 #
ETN-87-99755 ..... N87-21645 #
ETN-87-99756 ..... N87-21674 #
ETN-87-99761 ..... N87-21447 #
ETN-87-99762 ..... N87-21732 #
ETN-87-99763 ..... N87-21595 #
ETN-87-99766 ..... N87-21678 #
ETN-87-99773 ..... N87-21227 #
ETN-87-99774 ..... N87-21525 #
ETN-87-99775 ..... N87-21745 #
ETN-87-99777 ..... N87-21609 #
ETN-87-99791 ..... N87-21600 #
ETN-87-99792 ..... N87-21210 #
ETN-87-99793 ..... N87-21161 #
ETN-87-99794 ..... N87-21211 #
ETN-87-99795 ..... N87-21601 #
ETN-87-99796 ..... N87-21162 #
ETN-87-99797 ..... N87-21602 #
ETN-87-99798 ..... N87-21592 #
ETN-87-99799 ..... N87-21680 #
ETN-87-99800 ..... N87-21597
ETN-87-99801 ..... N87-21369
ETN-87-99806 ..... N87-21370
ETN-87-99807 ..... N87-21311
ETN-87-99808 ..... N87-21305
ETN-87-99812 ..... N87-21000 #
ETN-87-99813 ..... N87-20988 #
ETN-87-99814 ..... N87-20989 #
ETN-87-99815 ..... N87-21045 #
ETN-87-99841 ..... N87-21301 #

FFA-TN-1986-27 ..... N87-21400 #
FFA-TN-1986-40 ..... N87-20994 #
FFA-TN-1986-57 ..... N87-21401 #
FFA-TN-1986-71 ..... N87-21398 #

FHWA/RD-86/180 ..... N87-21167 #

FNAL/C-86/168-A ..... N87-21778 #

FNAL/PUB-86/159-A ..... N87-21779 #

FOA-C-30433-3.1/3.2/3.3/3.4 ..... N87-21227 #
FOA-C-30437-3.2 ..... N87-21525 #
FOA-C-30441-3.3 ..... N87-21745 #

FOA-30447-3.3 ..... N87-21609 #

FPR-2 ..... N87-21126 #

FR-1 ..... N87-21413* #

FTD-ID(RS)T-1204-86 ..... N87-21028 #

GARP-PUBL-26-VOL-1 ..... N87-21470 #
GARP-PUBL-27-VOL-1 ..... N87-21485 #

GDSS-SP-86-011-VOL-1A ..... N87-21018* #

GL-4132 ..... N87-21082 #
GL-4133 ..... N87-21662 #

GRI-86/0213 ..... N87-21137 #

H-1184 ..... N87-20986* #
H-1395 ..... N87-20991* #

HDL-TR-2099 ..... N87-21241 #

HEDL-SA-3527-FP ..... N87-21102 #

HMI-B336 ..... N87-21607 #
HMI-B371 ..... N87-21628 #
HMI-B431 ..... N87-21607 #

ICASE-87-20 ..... N87-21259* #
ICASE-87-23 ..... N87-21613* #

IFAORS-TR-248 ..... N87-21429* #

IFSR-255 ..... N87-21327 #

IMFL-86/21 ..... N87-21309 #

IMOU-R-86-15 ..... N87-21419 #

INSA-IDI-186-05 ..... N87-21687 #

INSA-IDI1-8603 ..... N87-21068 #

INSA-IDTC1-8602 ..... N87-21067 #

INSA-86-ISAL-0007 ..... N87-21290 #

IR-5 ..... N87-21692 #

ISBN-0-86039-265-1 ..... N87-20975
ISBN-0-86039-272-4 ..... N87-20977
ISBN-0-86039-283-X N87-21583
ISBN-0-86039-284-8 ..... N87-20954
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ISBN-951-38-2665-1 ..... N87-21110 #
ISBN-951-38-2708-9 ..... N87-21361 #
ISBN-951-38-2723-2 ..... N87-21399 #
ISBN-086039-267-8 ..... N87-20976

ISSN-0038-0911 ..... N87-21448 #
ISSN-0038-0911 ..... N87-21449 #
ISSN-0038-0911 ..... N87-21636 #
ISSN-0083-6443 ..... N87-21531
ISSN-0143-7143 ..... N87-21311
ISSN-0143-7313 ..... N87-21370
ISSN-0169-1651 ..... N87-21292 #
ISSN-0169-1708 ..... N87-20986 #
ISSN-0169-1708 ..... N87-21522 #
ISSN-0169-1708 ..... N87-21523 #
ISSN-0169-1708 ..... N87-21524 #
ISSN-0250-1589 ..... N87-21766 #
ISSN-0282-5369 ..... N87-21369
ISSN-0282-5369 ..... N87-21597
ISSN-0282-5369 ..... N87-21623
ISSN-0283-1694 ..... N87-21445 #
ISSN-0303-4003 ..... N87-21614 #
ISSN-0303-4003 ..... N87-21631 #
ISSN-0303-4003 ..... N87-21665 #
ISSN-0303-4003 ..... N87-21677 #
ISSN-0309-3067 ..... N87-21305
ISSN-0343-7639 ..... N87-21293 #

ISSN-0347-3708 ..... N87-21227 #
ISSN-0347-3708 ..... N87-21525 #
ISSN-0347-3708 ..... N87-21609 #
ISSN-0347-3708 ..... N87-21745 #
ISSN-0349-2656 ..... N87-21444 #
ISSN-0349-2699 ..... N87-21443 #
ISSN-0358-5077 ..... N87-21109 #
ISSN-0358-5077 ..... N87-21110 #
ISSN-0358-5077 ..... N87-21361 #
ISSN-0358-5077 ..... N87-21399 #
ISSN-0751-1353 ..... N87-21225 #
ISSN-0751-1353 ..... N87-21226 #

ISU-ERI-AMES-87018 ..... N87-21303* #

ITF-85-118-R ..... N87-21777 #

ITR-8 ..... N87-21217 #

JINR-R-2-85-667 ..... N87-21439 #

JPL-9950-1232 ..... N87-21413* #
JPL-9950-1234 ..... N87-21411* #
JPL-9950-1249 ..... N87-21412* #
JPL-9950-1274 ..... N87-21019* #

JPRS-USB-87-001 ..... N87-21558 #

JUEL-SPEZ-362 ..... N87-21293 #

K/CSD/INF-86/19P ..... N87-21739 #

K/TS-11811 ..... N87-21683 #

KFK-4135 ..... N87-21677 #
KFK-4138 ..... N87-21614 #
KFK-4154 ..... N87-21631 #
KFK-4163 ..... N87-21665 #

KGI-PREPRINT-096 ..... N87-21444 #

KGI-193 ..... N87-21445 #

KMSF-U-1828 ..... N87-21325 #

KNMI-TR-51 ..... N87-21522 #
KNMI-TR-51A ..... N87-21522 #
KNMI-TR-84 ..... N87-20966 #
KNMI-TR-85 ..... N87-21523 #
KNMI-TR-89 ..... N87-21524 #

KNMI-WR-86-3 ..... N87-21292 #

LA-UR-86-3395 ..... N87-21774 #
LA-UR-86-3512 ..... N87-21772 #
LA-UR-86-3572 ..... N87-21344 #
LA-UR-86-3684 ..... N87-21765 #
LA-UR-86-3785 ..... N87-21275 #
LA-UR-86-3882 ..... N87-21725 #
LA-UR-86-3907 ..... N87-21782 #
LA-UR-86-3908 ..... N87-21783 #
LA-UR-86-3942 ..... N87-21775 #
LA-UR-86-4110 ..... N87-21776 #
LA-UR-86-4208 ..... N87-21326 #
LA-UR-86-4285 ..... N87-21704 #
LA-UR-86-4286 ..... N87-21705 #
LA-UR-86-4339 ..... N87-21124 #
LA-UR-86-4346 ..... N87-21094 #
LA-UR-86-4352 ..... N87-21251 #
LA-UR-86-4362 ..... N87-21784 #
LA-UR-87-22 ..... N87-21322 #
LA-UR-87-99 ..... N87-21329 #
LA-UR-87-190 ..... N87-21328 #
LA-UR-87-358 ..... N87-21841 #

LA-10715-MS ..... N87-21391 #
LA-10839-MS ..... N87-21223 #
LA-10904-MS ..... N87-21440 #

LAAS-86-330 ..... N87-21718 #
LAAS-86-335 ..... N87-21358 #

LARC-TR-86-001 ..... N87-21316 #

LBL-21663 ..... N87-21093 #
LBL-22160 ..... N87-21392 #
LBL-22185 ..... N87-21701 #
LBL-22431 ..... N87-21700 #
LBL-22591 ..... N87-21104 #

LC-48-47112 ..... N87-21751 #
LC-79-640375 ..... N87-21448 #
LC-79-640375 ..... N87-21449 #
LC-79-640375 ..... N87-21836 #
LC-86-600083 ..... N87-21723 #
LC-86-600206 ..... N87-21733 #

LC-86-600551 ..... N87-21128 #
LC-86-600569 ..... N87-21754 #
LC-86-600583 ..... N87-21452 #
LC-86-600590 ..... N87-21750 #

LCC-018/85 ..... N87-21277 #

LMSC-HREC-TR-D951500-1 ..... N87-21016* #
LMSC-HREC-TR-D951500-1A ..... N87-21015* #
LMSC-HREC-TR-D951500-1B ..... N87-21017* #

M-559 ..... N87-21076* #

MDC-H3136 ..... N87-21835 #

MINTEK-M-270 ..... N87-21096 #

MIT/LCS/TR-368 ..... N87-21604 #
MIT/LCS/TR-372 ..... N87-21240 #

MITSG-86/11 ..... N87-21550 #

MLM-3400(OP) ..... N87-21390 #
MLM-3418 ..... N87-21164 #

MQAD-TP-911 ..... N87-21114 #

MRL-R-957 ..... N87-21079 #
MRL-R-1033 ..... N87-21009 #

MRL-TN-509 ..... N87-21006 #

MTI-PUB-87354-VOL-1-BK-1 ..... N87-21034* #
MTI-PUB-87354-VOL-1-BK-1-APP ..... N87-21035* #
MTI-PUB-87354-VOL-1-BK-2 ..... N87-21036* #

MTL-S-86117 ..... N87-21437 #

NADC-86105-60-VOL-1 ..... N87-21588 #
NADC-86123-60 ..... N87-21060 #
NADC-86139-60 ..... N87-21587 #

NAMRL-SR-86-1 ..... N87-21588 #

NARA/TIP-86/02 ..... N87-21737 #

NAS 1.15:87812 ..... N87-21534* #
NAS 1.15:88226 ..... N87-21006* #
NAS 1.15:88282 ..... N87-20991* #
NAS 1.15:88323 ..... N87-20982* #
NAS 1.15:88345 ..... N87-20967* #
NAS 1.15:88525 ..... N87-21307* #
NAS 1.15:89119 ..... N87-20966* #
NAS 1.15:89135 ..... N87-21377* #
NAS 1.15:89137 ..... N87-21021* #
NAS 1.15:89142 ..... N87-21376* #
NAS 1.15:89287 ..... N87-21075* #
NAS 1.15:89340 ..... N87-21780* #
NAS 1.15:89615 ..... N87-21078* #
NAS 1.15:89632 ..... N87-21756* #
NAS 1.15:89646 ..... N87-21043* #
NAS 1.15:89656 ..... N87-21037* #
NAS 1.15:89661 ..... N87-21375* #
NAS 1.15:89666 ..... N87-21077* #
NAS 1.21:7011(297) N87-21552*
NAS 1.21:7037(209) N87-20956*
NAS 1.21:7037(213) N87-20955*
NAS 1.26:4010 ..... N87-21585* #
NAS 1.26:4041 ..... N87-20996* #
NAS 1.26:4052 ..... N87-21257* #
NAS 1.26:177908 ..... N87-21764* #
NAS 1.26:177909 ..... N87-21834* #
NAS 1.26:178201 ..... N87-21373* #
NAS 1.26:178256 ..... N87-21429* #
NAS 1.26:178273 ..... N87-21259* #
NAS 1.26:178276 ..... N87-21020* #
NAS 1.26:178277 ..... N87-21613* #
NAS 1.26:179036 ..... N87-21140* #
NAS 1.26:179048 ..... N87-21034* #
NAS 1.26:179049 ..... N87-21035* #
NAS 1.26:179054 ..... N87-21036* #
NAS 1.26:179055 ..... N87-21018* #
NAS 1.26:179068-REV-1 ..... N87-21016* #
NAS 1.26:179069 ..... N87-21015* #
NAS 1.26:179070 ..... N87-21017* #
NAS 1.26:179074 ..... N87-21012* #
NAS 1.26:179075 ..... N87-21014* #
NAS 1.26:179076 ..... N87-21013* #
NAS 1.26:179576 ..... N87-21129* #
NAS 1.26:179597-VOL-1 ..... N87-21212* #
NAS 1.26:179597-VOL-2 ..... N87-21213* #
NAS 1.26:180220 ..... N87-21684* #
NAS 1.26:180221 ..... N87-21839* #
NAS 1.26:180265 ..... N87-21139* #
NAS 1.26:180272 ..... N87-21303* #
NAS 1.26:180441 ..... N87-20965* #

NAS 1.26:180442 ..... N87-21450* #
NAS 1.26:180456 ..... N87-21584* #
NAS 1.26:180496 ..... N87-21011* #
NAS 1.26:180505 ..... N87-21417* #
NAS 1.26:180508 ..... N87-21427* #
NAS 1.26:180510 ..... N87-21625* #
NAS 1.26:180511 ..... N87-21533* #
NAS 1.26:180513 ..... N87-21763* #
NAS 1.26:180514 ..... N87-21428* #
NAS 1.26:180519 ..... N87-21838* #
NAS 1.26:180524 ..... N87-21554* #
NAS 1.26:180525 ..... N87-21781* #
NAS 1.26:180526 ..... N87-21019* #
NAS 1.26:180527 ..... N87-21412* #
NAS 1.26:180528 ..... N87-21413* #
NAS 1.26:180530 ..... N87-21411* #
NAS 1.55:2449 ..... N87-21785* #
NAS 1.55:2465 ..... N87-21141* #
NAS 1.60:2395 ..... N87-20966* #
NAS 1.60:2678 ..... N87-20990* #
NAS 1.60:2715 ..... N87-21076* #
NAS 1.60:2719 ..... N87-21239* #

NASA-CASE-ARC-11511-2 ..... N87-21112*
NASA-CASE-ARC-11631-1 ..... N87-21255*

NASA-CASE-GSC-12897-1 ..... N87-21679*
NASA-CASE-GSC-13018-1 ..... N87-21232*

NASA-CASE-KSC-11282-1 ..... N87-21755*

NASA-CASE-LAR-13111-1-CU N87-21652*
NASA-CASE-LAR-13151-1 ..... N87-21235*
NASA-CASE-LAR-13280-1 ..... N87-20999*
NASA-CASE-LAR-13440-1 ..... N87-21653* #
NASA-CASE-LAR-13455-1 ..... N87-21206*

NASA-CASE-LEW-13899-1 ..... N87-21160*
NASA-CASE-LEW-13935-1 ..... N87-21234*

NASA-CASE-MFS-25956-1 ..... N87-21333*
NASA-CASE-MFS-25978-1 ..... N87-21410*
NASA-CASE-MFS-26058-1 ..... N87-21332*
NASA-CASE-MFS-26080-1 ..... N87-21233*
NASA-CASE-MFS-26090-1 ..... N87-21111*

NASA-CASE-NPO-15617-1 ..... N87-21304*
NASA-CASE-NPO-15982-1 ..... N87-21581*
NASA-CASE-NPO-16061-1-CU N87-21660*
NASA-CASE-NPO-16258-1 ..... N87-21207*
NASA-CASE-NPO-16393-1-CU N87-21159*
NASA-CASE-NPO-16423-1-CU N87-21334*
NASA-CASE-NPO-16640-1-CU N87-21661*

NASA-CP-2449 ..... N87-21785* #
NASA-CP-2465 ..... N87-21141* #

NASA-CR-4010 ..... N87-21585* #
NASA-CR-4041 ..... N87-20996* #
NASA-CR-4052 ..... N87-21257* #
NASA-CR-177908 ..... N87-21764* #
NASA-CR-177909 ..... N87-21834* #
NASA-CR-178201 ..... N87-21373* #
NASA-CR-178256 ..... N87-21429* #
NASA-CR-178273 ..... N87-21259* #
NASA-CR-178276 ..... N87-21020* #
NASA-CR-178277 ..... N87-21613* #
NASA-CR-179036 ..... N87-21140* #
NASA-CR-179048 ..... N87-21034* #
NASA-CR-179049 ..... N87-21035* #
NASA-CR-179054 ..... N87-21036* #
NASA-CR-179055 ..... N87-21018* #
NASA-CR-179068-REV-1 ..... N87-21016* #
NASA-CR-179069 ..... N87-21015* #
NASA-CR-179070 ..... N87-21017* #
NASA-CR-179074 ..... N87-21012* #
NASA-CR-179075 ..... N87-21014* #
NASA-CR-179076 ..... N87-21013* #
NASA-CR-179576 ..... N87-21129* #
NASA-CR-179597-VOL-1 ..... N87-21212* #
NASA-CR-179597-VOL-2 ..... N87-21213* #
NASA-CR-180220 ..... N87-21684* #
NASA-CR-180221 ..... N87-21839* #
NASA-CR-180265 ..... N87-21139* #
NASA-CR-180272 ..... N87-21303* #
NASA-CR-180441 ..... N87-20965* #
NASA-CR-180442 ..... N87-21450* #
NASA-CR-180456 ..... N87-21584* #
NASA-CR-180496 ..... N87-21011* #
NASA-CR-180505 ..... N87-21417* #
NASA-CR-180508 ..... N87-21427* #
NASA-CR-180510 ..... N87-21625* #
NASA-CR-180511 ..... N87-21533* #
NASA-CR-180513 ..... N87-21763* #
NASA-CR-180514 ..... N87-21428* #
NASA-CR-180519 ..... N87-21838* #

NASA-CR-180524 ..... N87-21554* #
NASA-CR-180525 ..... N87-21781* #
NASA-CR-180526 ..... N87-21019* #
NASA-CR-180527 ..... N87-21412* #
NASA-CR-180528 ..... N87-21413* #
NASA-CR-180530 ..... N87-21411* #

NASA-SP-7011(297) N87-21552*
NASA-SP-7037(209) N87-20956*
NASA-SP-7037(213) N87-20955*

NASA-TM-87812 ..... N87-21534* #
NASA-TM-88226 ..... N87-21006* #
NASA-TM-88262 ..... N87-20991* #
NASA-TM-88323 ..... N87-20982* #
NASA-TM-88345 ..... N87-20967* #
NASA-TM-88525 ..... N87-21307* #
NASA-TM-89119 ..... N87-20968* #
NASA-TM-89135 ..... N87-21377* #
NASA-TM-89137 ..... N87-21021* #
NASA-TM-89142 ..... N87-21376* #
NASA-TM-89287 ..... N87-21075* #
NASA-TM-89340 ..... N87-21760* #
NASA-TM-89615 ..... N87-21078* #
NASA-TM-89632 ..... N87-21756* #
NASA-TM-89646 ..... N87-21043* #
NASA-TM-89656 ..... N87-21037* #
NASA-TM-89661 ..... N87-21375* #
NASA-TM-89666 ..... N87-21077* #

NASA-TP-2395 ..... N87-20966* #
NASA-TP-2678 ..... N87-20990* #
NASA-TP-2715 ..... N87-21076* #
NASA-TP-2719 ..... N87-21239* #

NBS/GCR-86/521-VOL-1 ..... N87-21072 #

NBS/HB-14 ..... N87-21452 #

NBS/SP-305-SUPPL-17 ..... N87-21751 #
NBS/SP-500/144 ..... N87-21610 #
NBS/SP-726 ..... N87-21750 #

NBS/TN-1229 ..... N87-21724 #
NBS/TN-1305 ..... N87-21658 #

NBSIR-86-3061 ..... N87-21715 #
NBSIR-86-3334 ..... N87-21302 #
NBSIR-86-3414 ..... N87-21139* #
NBSIR-86-3448 ..... N87-21641 #
NBSIR-86-3457 ..... N87-21169 #
NBSIR-86-3495 ..... N87-21368 #
NBSIR-86/3056 ..... N87-21749 #
NBSIR-86/3469 ..... N87-21651 #
NBSIR-86/3486 ..... N87-21748 #

NCAR/TN-274+STR ..... N87-21837 #
NCAR/TN-275+STR ..... N87-21530 #

NEAR-TR-360 ..... N87-21010 #

NIKHEF-H/86-2 ..... N87-21663 #
NIKHEF-H/86-5 ..... N87-21664 #
NIKHEF-H/86-10 ..... N87-21676 #
NIKHEF-H/86-11 ..... N87-21726 #
NIKHEF-H/86-12 ..... N87-21310 #
NIKHEF-H/86-13 ..... N87-21727 #
NIKHEF-H/86-15 ..... N87-21728 #
NIKHEF-H/86-17 ..... N87-21744 #

NIPER-202 ..... N87-21135 #
NIPER-222 ..... N87-21136 #

NLR-MP-84029-U ..... N87-20981 #
NLR-MP-85011-U ..... N87-21741 #
NLR-MP-85015-U ..... N87-21408 #
NLR-MP-85028-U ..... N87-21742 #
NLR-MP-85037-U ..... N87-21621 #
NLR-MP-85039-U ..... N87-21605 #
NLR-MP-85042-U ..... N87-21606 #
NLR-MP-85070 ..... N87-21743 #
NLR-MP-85075-U ..... N87-21734 #
NLR-MP-85081-U ..... N87-21622 #
NLR-MP-85086-U ..... N87-21656 #
NLR-MP-85089-U ..... N87-21657 #

NMAB-430 ..... N87-20998 #

NOAA-TM-ERL-ARL-149 ..... N87-21426 #

NOAA-TM-NWS-NSSFC-13 ..... N87-21527 #
NOAA-TM-NWS-NSSFC-14 ..... N87-21528 #

NOR-86-221 ..... N87-21050 #

NORDA-126 ..... N87-21537 #

NOTA-INTERNA-868 ..... N87-21447 #
NOTA-INTERNA-869 ..... N87-21732 #
NOTA-INTERNA-870 ..... N87-21595 #
NOTA-INTERNA-873 ..... N87-21678 #

NPL-AC-109 ..... N87-21311

NPL-DITC-77/86 ..... N87-21623
NPL-DITC-79/86 ..... N87-21597
NPL-DITC-80/86 ..... N87-21369

NPL-DMA(A)-122 ..... N87-21370

NPL-MOM-80 ..... N87-21305

NPRDC-SR-87-1 ..... N87-21589 #

NPS-68-86-008 ..... N87-21544 #
NPS-68-86-012 ..... N87-21542 #
NPS-68-86-013-VOL-1 ..... N87-21535 #

NRL-MR-5883 ..... N87-21118 #
NRL-MR-5884 ..... N87-21266 #
NRL-MR-5886 ..... N87-21218 #
NRL-MR-5891 ..... N87-21214 #
NRL-MR-5893 ..... N87-21517 #
NRL-MR-5895 ..... N87-21685 #
NRL-MR-5901-PT-4 ..... N87-21242 #
NRL-MR-5905 ..... N87-21758 #

NRL-9000 ..... N87-20993 #
NRL-9022 ..... N87-21538 #

NSF/ENG-86008 ..... N87-21752 #

NSWC/TR-86-196 ..... N87-21090 #

NTIA-CR-86-37 ..... N87-21231 #

NTIA-86-199 ..... N87-21230 #
NTIA-86-203 ..... N87-21228 #
NTIA-86-204 ..... N87-21209 #
NTIA-86-207 ..... N87-21229 #

NTSB-AAB-86-28 ..... N87-20960 #

NU-MML-TR-87-1 ..... N87-21047 #

NUSC-OR-213 ..... N87-21364 #

ORNL/IRO-1 ..... N87-21738 #

ORNL/SUB-85-22006/1 ..... N87-21092 #

ORNL/TM-9998 ..... N87-21282 #
ORNL/TM-10109 ..... N87-21355 #
ORNL/TM-10166 ..... N87-21415 #
ORNL/TM-10267 ..... N87-21675 #

OSDIT/FSMC-86/006 ..... N87-21611 #

OSU/DGSS-371 ..... N87-21435 #
OSU/DGSS-372 ..... N87-21431 #

OTA-BP-ISC-41 ..... N87-21754 #

OTA-TM-E-32 ..... N87-21128 #

OUEL-1648/86 ..... N87-21627 #

PB86-916928 ..... N87-20980 #
PB87-109864 ..... N87-21649 #
PB87-113874 ..... N87-21426 #
PB87-115523 ..... N87-21752 #
PB87-115804 ..... N87-21659 #
PB87-116687 ..... N87-20987 #
PB87-116968 ..... N87-21723 #
PB87-118220 ..... N87-21754 #
PB87-118253 ..... N87-21128 #
PB87-118444 ..... N87-21168 #
PB87-118873 ..... N87-21113 #
PB87-118960 ..... N87-21451 #
PB87-120523 ..... N87-21230 #
PB87-120531 ..... N87-20998 #
PB87-122123 ..... N87-21167 #
PB87-124293 ..... N87-21228 #
PB87-126256 ..... N87-21737 #
PB87-126397 ..... N87-21636 #
PB87-126405 ..... N87-21229 #
PB87-126561 ..... N87-21450* #
PB87-126611 ..... N87-21646 #
PB87-126645 ..... N87-21073 #
PB87-126942 ..... N87-21611 #
PB87-127379 ..... N87-21736*
PB87-129417 ..... N87-21526 #
PB87-129425 ..... N87-21420 #
PB87-129433 ..... N87-21532 #
PB87-129456 ..... N87-21531
PB87-131009 ..... N87-21612 #
PB87-131165 ..... N87-21231 #
PB87-131173 ..... N87-21209 #
PB87-133245 ..... N87-21553 #
PB87-133252 ..... N87-21303* #
PB87-134367 ..... N87-21658 #
PB87-134458 ..... N87-21403 #
PB87-136677 ..... N87-21750 #
PB87-137105 ..... N87-21550 #
PB87-137139 ..... N87-21527 #
PB87-137147 ..... N87-21528 #
PB87-137154 ..... N87-21650 #
PB87-137196 ..... N87-21598 #
PB87-137220 ..... N87-21138 #
PB87-137238 ..... N87-21254 #
PB87-137766 ..... N87-21448 #
PB87-137774 ..... N87-21449 #
PB87-138095 ..... N87-21837 #
PB87-138194 ..... N87-21549 #
PB87-140174 ..... N87-21368 #
PB87-140240 ..... N87-21072 #
PB87-140257 ..... N87-21302 #
PB87-140265 ..... N87-21169 #
PB87-140273 ..... N87-21748 #
PB87-140315 ..... N87-21651 #
PB87-140414 ..... N87-21724 #
PB87-140422 ..... N87-21452 #
PB87-140570 ..... N87-21139* #
PB87-140729 ..... N87-21749 #
PB87-140737 ..... N87-21733 #
PB87-140810 ..... N87-21610 #
PB87-141057 ..... N87-21529 #
PB87-141511 ..... N87-21530 #
PB87-142162 ..... N87-21551 #
PB87-142196 ..... N87-21557 #
PB87-142915 ..... N87-21746 #
PB87-142923 ..... N87-21747 #
PB87-144325 ..... N87-21137 #
PB87-145272 ..... N87-21751 #
PB87-145660 ..... N87-21421 #
PB87-145736 ..... N87-21074 #
PB87-152365 ..... N87-21641 #

PD-NW-85-327R-1 ..... N87-21430 #

PNL-SA-14370 ..... N87-21105 #

POLY-WRI-1505-86 ..... N87-21247 #
POLY-WRI-1506-87 ..... N87-21245 #

PREPRINT-513 ..... N87-21632 #
PREPRINT-514 ..... N87-21638 #
PREPRINT-515 ..... N87-21666 #
PREPRINT-518 ..... N87-21639 #
PREPRINT-519 ..... N87-21643 #
PREPRINT-520 ..... N87-21667 #
PREPRINT-521 ..... N87-21721 #
PREPRINT-522 ..... N87-21633 #
PREPRINT-523 ..... N87-21634 #
PREPRINT-524 ..... N87-21635 #
PREPRINT-525 ..... N87-21636 #
PREPRINT-526 ..... N87-21668 #
PREPRINT-527 ..... N87-21729 #
PREPRINT-528 ..... N87-21669 #
PREPRINT-529 ..... N87-21670 #
PREPRINT-530 ..... N87-21671 #
PREPRINT-531 ..... N87-21672 #
PREPRINT-532 ..... N87-21730 #
PREPRINT-533 ..... N87-21731 #
PREPRINT-534 ..... N87-21071 #
PREPRINT-535 ..... N87-21722 #
PREPRINT-536 ..... N87-21644 #
PREPRINT-537 ..... N87-21673 #
PREPRINT-538 ..... N87-21402 #
PREPRINT-539 ..... N87-21640 #
PREPRINT-540 ..... N87-21645 #
PREPRINT-542 ..... N87-21674 #

PSI-034/TR-579 ..... N87-21315 #

PV-M5-517700 ..... N87-21126 #

R/D-4038-AN ..... N87-21387 #

RA-227 ..... N87-21208

RADC-TR-86-135 ..... N87-21221 #
RADC-TR-86-142 ..... N87-21243 #
RADC-TR-86-148 ..... N87-21362 #

RAE-MAT/STR-36 ..... N87-20988 #
RAE-MAT/STR-131 ..... N87-20989 #
RAE-MAT/STR-133 ..... N87-21041 #
RAE-MAT/STR-145 ..... N87-21045 #

RAE-SPACE-640 ..... N87-21405 #

RAE-STRUCT/BF/B/0816 ..... N87-21000 #

RAE-TM-P-1077 ..... N87-21306 #

RAE-TM-SPACE-355 ..... N87-21033 #

RAE-TR-86047 ..... N87-21000 #
RAE-TR-83023 ..... N87-20988 #
RAE-TR-84103 ..... N87-21405 #
RAE-TR-85057 ..... N87-20989 #
RAE-TR-85059 ..... N87-21041 #
RAE-TR-85087 ..... N87-21045 #

RAE-TRANS-2143 ..... N87-20981 #
RAE-TRANS-2151 ..... N87-21624 #

RARDE-MEMO-6/86 ..... N87-21236 #

REPT-87B0163 ..... N87-21534* #
REPT-642-BA004/007 ..... N87-21019* #
REPT-699-099-202 ..... N87-21373* #
REPT-4950-FTR-86-4 ..... N87-21001 #
REPT-8720-3179U ..... N87-20997 #

RFP-3926 ..... N87-21108 #
RFP-4060 ..... N87-21347 #

RID-1912 ..... N87-21005 #

RSRE-MEMO-3715 ..... N87-21161 #
RSRE-MEMO-3889 ..... N87-21211 #
RSRE-MEMO-3915 ..... N87-21601 #
RSRE-MEMO-3952 ..... N87-21162 #
RSRE-MEMO-3965 ..... N87-21237 #
RSRE-MEMO-3966 ..... N87-21602 #
RSRE-MEMO-3967 ..... N87-21238 #
RSRE-MEMO-3977 ..... N87-21599 #
RSRE-MEMO-3982 ..... N87-21592 #
RSRE-MEMO-3993 ..... N87-21680 #

RSRE-86003 ..... N87-21600 #
RSRE-86011 ..... N87-21210 #

RTR-041-02-VOL-1 ..... N87-21012* #
RTR-041-02-VOL-2 ..... N87-21014* #
RTR-041-02-VOL-3 ..... N87-21013* #

RX-861001 ..... N87-21032 #

SAND-86-0790C ..... N87-21280 #
SAND-86-1278C ..... N87-21323 #
SAND-86-1349C ..... N87-21318 #
SAND-86-1698C ..... N87-21308 #
SAND-86-1739C ..... N87-21395 #
SAND-86-1821C ..... N87-21703 #
SAND-86-2156C ..... N87-21394 #
SAND-86-2334C ..... N87-21713 #
SAND-86-2960C ..... N87-20972 #
SAND-86-7048 ..... N87-21416 #
SAND-86-7163 ..... N87-21107 #
SAND-87-0182C ..... N87-21711 #
SAND-87-0229C ..... N87-21353 #
SAND-87-7061 ..... N87-21250 #

SAPR-32 ..... N87-21763* #
SAPR-33 ..... N87-21763* #

SC5411.AR ..... N87-21313 #

SD-TR-86-20 ..... N87-21062 #
SD-TR-86-81 ..... N87-21046 #
SD-TR-86-92 ..... N87-21024 #
SD-TR-86-94 ..... N87-21314 #
SD-TR-86-96 ..... N87-21312 #
SD-TR-86-103 ..... N87-21215 #

SEI-TR-86-13 ..... N87-21388 #

SERI/TR-252-2942 ..... N87-21285 #

SGD-506-PT-2 ..... N87-21836 #
SGD-507-PT-1 ..... N87-21448 #
SGD-507-PT-2 ..... N87-21449 #

SM-86-21 ..... N87-21384 #

SR-1 ..... N87-21032 #
SR-1 ..... N87-21435 #
SR-1 ..... N87-21436 #
SR-2 ..... N87-21027 #
SR-8 ..... N87-21549 #

SRA-R-920018-F ..... N87-21693 #

SRA-R87-920027-F ..... N87-21263 #

SU-CSSA-ASTRO-86-39 ..... N87-21838* #

SUMX-C83-142 ..... N87-21083 #

SYRU/DECE/TR-86/4 ..... N87-21217 #

TAE-581 ..... N87-21374 #

TANTALUS/GT-86/1 ..... N87-21752 #

TASC-TR-5054-1-1 ..... N87-21362 #

TAUP/P-48 ..... N87-21648 #

TG27886 ..... N87-21019* #

TR-3 ..... N87-21411* #
TR-4 ..... N87-21084 #
TR-5 ..... N87-21085 #
TR-0084A(5935-14)-3 ..... N87-21046 #
TR-0086(6060)-3 ..... N87-21314 #
TR-0086(6907)-1 ..... N87-21312 #
TR-0086(6925-05)-6 ..... N87-21215 #
TR-0086(6940-05)-13 ..... N87-21024 #
TR-0086(6945-04)-1 ..... N87-21062 #

TTU-IDR-80D ..... N87-21113 #

UAH-592 ..... N87-21140* #

UCID-20762-REV-1 ..... N87-21438 #
UCID-20957 ..... N87-21279 #

UCRL-53774 ..... N87-21283 #
UCRL-94192 ..... N87-21224 #
UCRL-94386 ..... N87-21348 #
UCRL-95040 ..... N87-21320 #
UCRL-95317 ..... N87-21642 #
UCRL-95416 ..... N87-21771 #
UCRL-95516 ..... N87-21317 #
UCRL-95532 ..... N87-21757 #
UCRL-95582 ..... N87-21274 #
UCRL-95845 ..... N87-21330 #
UCRL-95866 ..... N87-21281 #
UCRL-95923 ..... N87-21252 #
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UDR-TR-86-139 ..... N87-21278 #

UDRI-TR-86-14 ..... N87-21121 #

UIEC-86-10 ..... N87-21216 #

UILU-ENG-86-2562 ..... N87-21216 #

UIO-SR-86-02 ..... N87-21443 #

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